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The Fifteen Cubic Yard Dredge for Panama Slides

The Making of a Fourteen-Inch "Dreadnaught" Gun

New Designs in Aeroplanes

Vol. CX. No. 19
May 9, 1914

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New York, N. Y.

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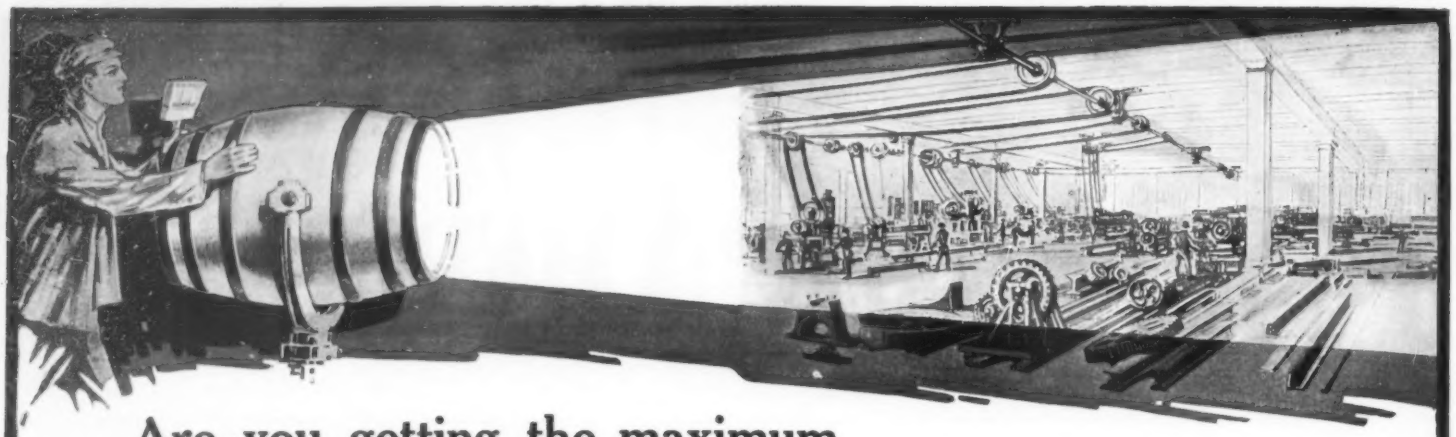

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SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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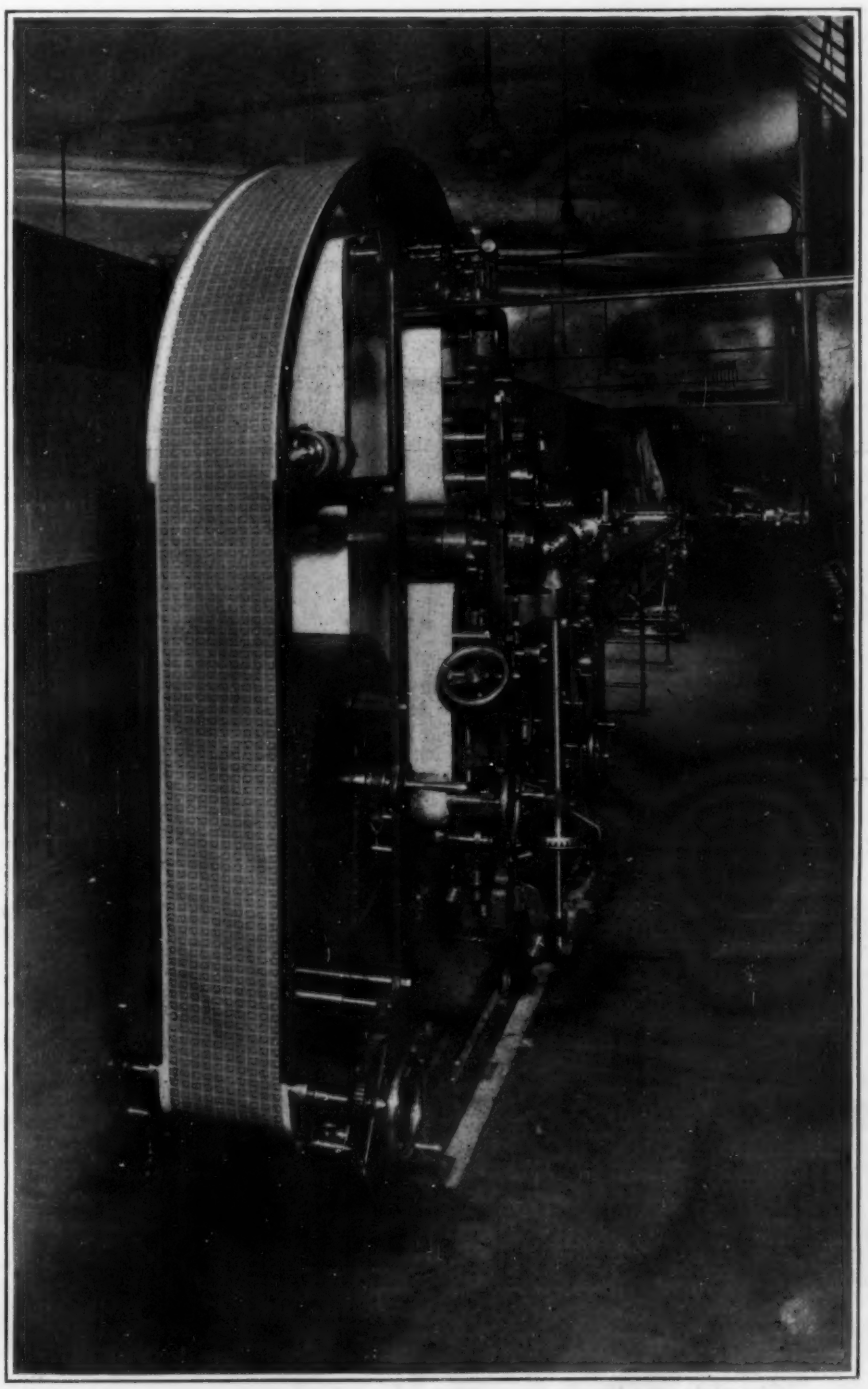
New Stamp Printing Machine of the Bureau of Engraving and Printing

WHEN a man purchases a penny postage stamp, he is quite apt to overlook the cost of producing that stamp and think that the whole of his investment will go toward paying the expense of sending his missive to its destination. To be sure, the cost of production is almost negligible when calculated for a single stamp, but when he learns that about forty million stamps must be printed daily to supply the demands of our letter writing population, he realizes that the annual bill for printing postage stamps amounts to a very considerable figure.

The manufacturing cost has been reduced materially of late by the inventions of Mr. Benjamin R. Stickney, mechanical expert and designer of the Bureau, working under direction of Mr. Joseph B. Ralph, Director of the Bureau of Engraving and Printing. As postage stamps are printed from engraved plates, the ordinary high-speed printing processes are not applicable to them. Ordinarily, it is necessary to moisten the paper so that it may readily be pressed into the engraved lines of the plates to pick out the ink that fills them. The common press cannot exert sufficient pressure upon the paper to make good prints if the paper is dry. And so up to a recent date all the paper had to be moistened by hand, which was a slow and costly process. Then about four years ago Mr. Stickney invented a machine for wetting paper, and he followed this up two years ago with a stamp printing machine that would print on a roll of dry paper. Not only did this eliminate the bothersome operation of wetting the paper, but it reduced the clerical work of keeping track of the separate sheets on which the stamps were printed; for now they were printed on continuous rolls at the rate of 12,000 postage stamps per minute.

This high-speed machine has since been further improved, and it now appears as in the accompanying engraving. The paper is fed from the drum shown in the foreground. It passes up over rollers, and then down between the feed roller and the printing cylinder. Here an enormous pressure is put upon the dry paper, which forces it into every line of the engraving. At the back of the cylinder is the inking font, below which are metal fingers, covering a space about 8 inches wide and extending the full length of the cylinder. The fingers vibrate lengthwise on the cylinder. A wiping belt vibrates with the fingers, but at the same time moves forward, wiping the surface of the cylinder as clean, as if the work were done by hand.

In Mr. Stickney's first machine, the paper passed from the printing cylinder over a series of electrically heated rollers to dry the ink. In the present machine the strip of stamps passes upwardly, and, in the language of the Bureau of Engraving and Printing, "loops the loop" over a long curved upper plate heated by electricity, as may be seen in the foreground of our photograph. The stamp strip then passes under a roller at the extreme lower front and proceeds rearwardly to the gumming font. After being automatically gummed, it passes into a steam-heated drying shaft about 25 feet long. From the drying shaft it enters the perforator and slitter and is discharged from the machine in long strips that are coiled up like ribbon.



New rotary stamp printing machine of the Bureau of Engraving and Printing.

An Underground Canal

A PIECE of engineering work of considerable scope in the shape of an underground canal is now going on in the south of France, the object being to complete the waterway across the country. Starting from Havre, boats can pass by the Seine, the Saone and the Rhône with their junction canals as far as Lyons and from there to Arles, but access to the Mediterranean is prevented on account of the fact that the Rhône is no longer navigable after that point. Work is now carried out upon a canal which will make connection from the Rhône at Arles to Marseilles, of about fifty miles length. On the course lies the large lake known as Etang de Berre, which will be reached by open canal. From the lake to Marseilles a mountain chain cuts off the way, so that the canal must be run in tunnel from here to the sea. As the underground canal needs to be of large section, and is some 4½ miles long, this represents quite an undertaking, and will use most of the $15,000,000 allotted for the canal enterprise. A circular arch section is used, with narrow towpath on each side, the width of the section being 73 feet and height 51 feet, so that its section will be eight times that of the Paris subway. The canal itself occupies a rectangular section 10 feet deep and 60 feet wide. At present this work is under way, and will represent some 2,000,000 cubic feet of rock excavated and emptied into the sea. Electric cables bring over 2,000 horse-power for the drills and other machines, besides the electric locomotives for spoil trains. The canal will be on sea level as far as Arles, with locks from thence to the Rhône level. Great economic consequences are expected, and the above-mentioned lake will form an inland sea depending on Marseilles, and its shores will no doubt be covered with maritime and industrial establishments. Marseilles will now become a river port as well as a seaport, and Lyons will connect with the Mediterranean.

How Paris Disposes of City Waste

QUITE an elaborate system is soon to be put in operation for disposing of the great amount of household waste of the city of Paris. At present there are used 730 large wagons of 180 cubic foot capacity, 1,500 horses, and 3,000 men, and the annual amount is estimated at 900,000 tons, or 2,600 tons per day. On the old system, Seine flats took the material either to sea or river points, or it was transported to the surrounding country. But a modern method is to be organized which involves the use of electric trucks and a system of five large consuming plants in the suburbs at different points around the city. Two of the plants are now in operation, and the electric trucks are being introduced by degrees. At the St. Ouen consuming works all is laid out on approved ideas, and the electric trucks discharge automatically into a pit 300 feet wide, at the bottom of which is a set of belt conveyors for taking the material either direct to the grinding mills or to the consuming furnaces. Other conveyors take the material and discharge it into silos above the furnaces. After combustion at about 1,000 deg. Cent. there is left a residue resembling slag or clinker. Suitable means are provided for taking the clinker to a mill, where it is ground and mixed with lime so as to make up bricks. Hot gases from the furnaces serve to heat the boilers and supply steam turbines for producing not only all the power needed on the premises, but a considerable amount sent outside. As much as 900 tons of waste is handled per day.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Plans of the Cup Defenders

WE direct attention to the unusually complete plans of the cup-defenders of the "America's" Cup, which were published in the last issue of the SCIENTIFIC AMERICAN. This material is presented in recognition of the widespread interest which is aroused whenever a challenge reaches this country for a series of races for the greatly coveted yachting trophy.

In no previous contest has so much informing data been available thus early in the season. It has been withheld from publication until the construction of the yachts had reached a stage at which it was too late to make any alterations, either in hull or sail plan, based upon "what the other fellow was doing."

The three designers, Herreshoff, Gardner, and Owen, have worked absolutely independently of each other—and the result has been the production of three widely different yachts, and a complete covering of the field. Nicholson, the designer of the "Shamrock IV," is "up against" a strong combination; and if the visitor, after crossing three thousand miles of ocean, and competing in unfamiliar water, can win the cup—so much the greater will be his glory!

The Plight of the Railroads

LET us be fair to the railroads. They are asking the Government to permit them to make a moderate increase in rates, basing their plea upon the ground that the increase both in wages and in the cost of materials of late years has been so great as to make it necessary for them to increase their freight rates if they are to maintain their systems in good condition and return a reasonable profit to the stockholders.

Is this request a reasonable one? It is our belief that a review of the facts would justify the Interstate Commerce Commission in permitting many, if not all, of the railroads which have preferred the request to make the desired increase. Every one knows that the cost of labor and the price of materials and of all purchasable commodities have been increasing, in many cases, by leaps and bounds. And it by no means follows that because a corporation's activities involve the turning over of hundreds of millions of dollars a year, that therefore it has not in considerable measure felt the pressure of these changed conditions.

We have before us some statistics regarding the New York, New Haven, and Hartford Railway, which have been sent to us by its new president, Howard Elliott. The pamphlet presents facts and figures regarding the situation on one of our leading railroads, of the correctness of which there can be no doubt whatsoever. Regarding the increased pay of employees, it is sufficient to say that three reports made by the New Haven Railroad to the Interstate Commerce Commission for three periods, five years apart, show that the average yearly wages based on the number of men employed have risen from $633.69 in 1903 to $763.38 in 1908 and $815.49 in 1913. In the ten years from 1903 to 1913 there has been an increase in the number of men employed of 11 per cent; an increase in the total compensation of 43 per cent; and an increase in the average yearly wage of 29 per cent. Furthermore, we are informed that during the fiscal year ending June 30th, 1914, the increase in the rates of pay will have increased the total payroll about $800,000 over the previous year.

There has been a large increase in cost of railroad operation, etc., due to legislative acts and requirements. Thus the Nine Hour law, the Ash-pan law, the Safety Appliance law, the Boiler Inspection law, and the Full Crew law, have increased the expense of the company nearly $200,000 per year. Ten years ago the cost of accounting was $190,000 per year, to-day it is about $500,000 per year, and part of this increase is due to the accounting requirements of the Interstate Commerce and State Commissions. The Federal Act calling for the valuation of railways will add another $60,000 per year to the expenses of the company. Commenting on these facts, President Elliott says that they are not quoted in any spirit of criticism, but merely to show the effect that they have had upon the income of the company.

On the question of freight and passenger rates, we learn that, although the capital investment of the company and its operating expenses have been increased, the freight rates on the whole have remained stationary or have decreased. Thus, in ten years there has been a reduction of 69/1,000 of a cent in the average rate received for hauling 2,000 pounds of freight one mile. Now this seems to be a very small sum; but when it is applied to the frieght business of the New Haven Road for the year ending June 30th, 1913, it is found that it represents a loss of freight earnings of $1,800,000. The increase in wages and the decline in freight rates, alone, make a difference of over $9,000,000 a year in income, equal to 6 per cent interest on a capital of $150,000,000.

An interesting fact in connection with the New Haven Railroad is that it is essentially a passenger railroad; for whereas on the railroads of the country as a whole two tons of freight are carried for each passenger, on the New Haven only one third of a ton is carried per passenger. During eight months of this year, the passenger earnings were 50.6 per cent, and the freight earnings 49.4 per cent of the revenue from transportation. The revenue per passenger train-mile was $1.90 and per freight train-mile $4.17. Again, the commutation and trip-ticket passengers, which are the unremunerative class of passenger travel, comprised 43 per cent of the total passengers carried, and they yielded only 13.6 per cent of the total passenger revenue. Taken as a whole, President Elliott states that, because of low passenger fares and the increasing cost of service, much of the passenger service is operated for the convenience of the public at a positive loss, and the whole passenger service only just pays its operating expenses. Hence the justice of making a reasonable increase in the passenger rates is obvious.

Reconnoitering at Santiago and at Vera Cruz

THE events of the Spanish-American war are not so far removed but most of us have a distinct recollection of the anxiety which was occasioned by the dispatch of Cervera's squadron of four armored cruisers and some torpedo-boat destroyers from Spanish to American waters. It was known that Cervera had sailed; but as to his destination there was, even in our Navy, considerable doubt and much resulting perplexity. As will always be the case in hostilities involving naval operations, our towns and cities along the seaboard became suddenly aware of the vast importance of a navy, and the timorous property holders and municipalities clamored loudly for the protection of a cruiser, battleship or something that could shoot with big guns. Meanwhile, when our scouts, improvised and otherwise, were scouring the seas in search of the Spanish admiral, he had slipped quietly into Santiago harbor, where he lay snugly screened from observation behind the rather lofty hills which encircle that anchorage.

Nor have so many years intervened since that interesting episode but most of us will recall the long-range observation of the entrance to Santiago harbor by Admiral Schley, and the many speculations indulged in by himself, the public press, and everybody else, as to whether the Spanish ships were or were not hidden inside the snug little harbor.

Vastly different are the conditions sixteen years later at the port of Vera Cruz, Mexico—different, that is to say, so far as the question of obtaining accurate information of the strength and location of the enemy is concerned. Although our enlisted men and marines had landed in considerable force and held the city, there was considerable uncertainty as to number and position of the enemy's forces outside the city. Rumor had it that heavy reinforcements had been dispatched from various points to Gen. Maas, who had been in command at Vera Cruz, and it was stated that he was making ready for an attack on the city with overwhelming numbers. Most important was it that Admiral Fletcher should be informed on this point and learn what was the condition of the railroad line from Vera Cruz to Mexico, and particularly of some important bridges on that line. It was impossible to spare sufficient officers and men for an adequate reconnaissance, and for a while the situation appeared to be somewhat critical. Then there steamed into port the "Mississippi," and, shortly after her arrival, the naval aeroplanes had ascended and were making a searching reconnaissance of the outlying districts about Vera Cruz and along the route of the railroad. The Mexican forces, very limited in number, were located, and the whole military situation at and about Vera Cruz was cleared up.

There is a world of significance in a comparison of the situation at these two ports in the West Indies and the Gulf; and once more the aeroplane has proved its inestimable value as a means of obtaining definite knowledge of the strength and position of the enemy.

Annual Loans for Naval Construction

WE direct attention to the letter signed "Navy" in our correspondence columns, which draws attention to startling conditions in the naval situation. The author is well known to us, and is one of our most capable naval officers, who has spent many years abroad in close touch with the naval and diplomatic situation.

The statement that some of the leading powers are supplementing their first annual naval appropriations with large annual loans, spread out over a number of years, does not surprise us. Increasingly, it is being understood that the command of the sea may mean the command of the whole situation, military as well as naval—and particularly so in the case of nations which possess an extensive littoral or an oversea trade of large proportions. The determined way in which Germany, France, and Japan are building up their fleets is not to be attributed to any mere "jingo" spirit. The motives that prompt the policy are of a lofty and patriotic character, and these large increases are the result of a broad, intelligent, and thoughtful review of the whole international situation.

The facts brought out in the letter referred to point with increasing emphasis to the need for the formation of a Council of National Defense—a representative body, with the President at its head, which, after a review of the whole naval situation the world over, shall determine upon a fixed policy of naval construction, based upon our present and probable future necessities.

Predicting Nile Floods

THE prediction of the Nile flood has been a cherished ambition of the Egyptian meteorological service for a number of years. The stages of the Nile depend upon the rainfall of Abyssinia, and this, in turn, is supposed to be supplied by moisture-bearing winds blowing across the continent from the Atlantic Ocean. Accordingly the attempted predictions are based upon observations of pressure and wind velocity at St. Helena, and pressure in South America, which indicate the activity of the atmospheric circulation over the South Atlantic. It has been found that the mean error of a prediction from these data for the mean height of the Nile at Halfa between July 16th and August 15th, which normally corresponds to the middle of the rising stage, is ± 0.33 meter, whereas a prediction that assumes that the river will be normal in any given year would have a probable error of ± 0.55 meter. According to Mr. Hurst of the Egyptian Meteorological Office, this result is sufficiently encouraging to warrant a continuation of the investigation, considering the vast importance of the problem to the welfare of Egypt.

The Cooling of the Earth

THE application of Stefan's law to the calculation of the mean temperature of the Earth, at a given latitude, shows that at the latitude of 80 degrees, the temperature was in the neighborhood of 90 deg. Cent., when the Sun's radius was about one and a half times its present dimensions, i. e., about two million years ago. Thus it would appear that life commenced on the Earth in the vicinity of the poles. The same reasoning leads us to the conclusion that in less than two million years, when the Sun's radius will be reduced by one tenth of its present value, the temperature on the Earth will have fallen below 0 degree, even at the equator.

Evaporation and Stream Flow

AN investigation of evaporation and stream flow is being carried out by Prof. John F. Hayford of Northwestern University with the aid of a grant from the Carnegie Institution. Instead of using apparatus on a small scale to measure evaporation, Prof. Hayford proposes to consider each of the Great Lakes in turn as an evaporation pan, evaluate the income, outgo (other than evaporation) and change of content of the lake, and from these data to determine the daily evaporation in its relation to meteorological conditions. Ultimately the knowledge thus acquired will be applied to a study of the laws of stream flow in the United States.

Engineering

Engineering Graduates Become Engineers.—The statement that graduates of engineering schools do not follow the engineering profession is shown to be erroneous in the case at least of the College of Engineering of the University of Illinois. Data recently collected by the College show that of the 2,165 graduates, 1,933, or 89 per cent, are engaged in one way or another in engineering work, and that only 173, or about 8 per cent, have gone into other fields.

A Japanese Test Car.—A dynamometer car which has been designed for the Imperial Government Railways of Japan by Prof. E. C. Schmidt of the Railway Department of the University of Illinois, is expected to be received at Urbana this month, when the final assembling will be done. This car is being built by a prominent Chicago manufacturing company. After it has been assembled at Urbana it will be given a short preliminary run to see that everything is working perfectly, and will then be taken apart and shipped to Japan.

Preparing for the San Francisco Exposition.—By way of preparation for the heavy travel which is expected in connection with the Panama Exposition at San Francisco, the Union Pacific Railroad Company has recently placed an order for 54 locomotives costing about $1,000,000. Twenty-five of these are of the Pacific type, 15 are Mikados and 14 are of the six-connected type. Forty of the locomotives will go to the Union Pacific, 10 to the Oregon Short Line and 4 to the Oregon-Washington line.

The New German Torpedo.—The latest dreadnought cruisers and destroyers of the German navy, including all built since and during 1909, are armed with the new 21.6 torpedo, which is about 17 feet long and carries a bursting charge of no less than 290 pounds. The range is 7,500 yards, and the explosive in the head is known as trinitrotoluene, which is far more powerful than the guncotton used in the old 18-inch torpedo. In fact, the Germans believe that a single hit from the new torpedo would disable even the largest of the present dreadnoughts.

Herald Square Subway Station.—Construction of the new express station of the Broadway line at Herald Square will constitute this one of the most important traffic centers in this city. When the station and the extension of the Hudson tubes to the Grand Central Station have been completed there will be no less than six separate transit lines at this point, including three surface car lines, the Sixth Avenue Elevated, the Broadway line and the Hudson tubes, the whole being carried at four different levels. This station will reach from 32nd Street to 35th Street, and will be provided with eleven separate entrances.

Steam Turbine Pumps.—In Germany the first water works to recognize the many advantages of the steam turbine pump, as embodied in the new Allgemeine machines, was the one situated at Beelitzhof Works. Compared with the piston machines already in use there, it was seen to be much better, and this led the company to put in a new group having an output of 1,200 cubic feet a minute with a lift of 200 to 350 feet. This group is of improved type, with a steam turbine coupled on the same base to a rotary pump. All the water elevated by the pump is made to pass through the condenser (placed in the basement), so that an excellent cooling effect is the result, and the quantity of water is so large that it does not heat up to any extent.

Mississippi River Bridge to be Built at New Orleans.—It seems that the project of a bridge over the Mississippi near New Orleans, first proposed in 1888, is to be put through. The original design was for a crossing about four or five miles above New Orleans, where no change of bed or banks has occurred in the recorded history of the river. The span of the cantilever bridge was to be 1,070 feet between centers of main piers, the suspended span being 440 feet long and the anchor arms each 660 feet 8 inches in length. The foundations were to extend to 170 feet below low water and were to rest upon a bed of firm sand. The piers were to be sunk by dredging through open wells or cylinders. The present plan calls for a double deck bridge, one deck for highway and electric railway travel, and the other for railway service.

A New Road-Mending Machine.—An experimental test has been made in Paris of a portable road-mending machine, consisting of a six horse-power gasoline engine, actuating an air compressor, the air being led from a storage tank to a pneumatic rammer and a pneumatic pick, the latter being described as merely a modification of the well-known pneumatic riveter. The workman holds the tool close to the road and pushes the pick under the surface, raising it up as he proceeds. It is said that the work was done at a much faster rate than was possible with the ordinary pick. The pneumatic rammer also gave good results. One advantage of the system is that several men can work from the same compressor plant. The trial seems to indicate that mechanical road-mending is more effective than the present method.

Automobile

Catering to Convenience.—The manufacturer of a British car has provided an exceptionally simple means for cleaning the fuel tanks on his cars. He has merely made the filler cap large enough to admit a man's hand and arm. Incidentally, the large filling orifice facilitates replenishing the supply and as it makes possible heavy, substantial threads on the cap it eliminates the chance of their failure.

Protecting the Chauffeur from Head-Lights.—In patent 1,089,539 Theodore P. Driver of Melrose, Mass., shows a pair of chauffeur's spectacles in which are provided a row of three or more vertically arranged non-contiguous slats or screens. These are so arranged that the space between them is such as to afford no material obstruction to the straight ahead view, although they will operate to cut off the rays from approaching head-lights.

A Timing and Indicating Device for Vehicles.—John F. Burns of San Francisco and his assignees, Robert Colman and F. M. Auliffe, both of the same place, show in patent No. 1,090,382 an apparatus for indicating the letting of vehicles, which apparatus has a suitable timing and indicating device actuated by the seating of a passenger, the door of the vehicle controlling means for interrupting a movement of the timing and indicating device.

Germany's Municipal Motors.—A careful circular campaign has revealed that of 58 German cities having populations of more than 80,000, only 5 are without municipal motor wagons; one of these has a vehicle on order. The number of vehicles in each city varies from 1 to 52 per capita, the total number being 590. Of these, the fire brigades have 249; street cleaning and watering, 113; and ambulances, 54; the remainder are used for miscellaneous service.

A Two-Cycle Engine Competition.—By way of stimulating interest in the two-stroke automobile motor, the Royal Automobile Club of Great Britain, which already has done much to advance automobile science, has decided to organize a competition for motors of that kind. So far, nothing regarding the test has been permitted to become public, except that the test will require the engines to be fitted to a chassis and submitted to the Technical Committee of the club for certified trials. Further details probably will be forthcoming in the near future.

Agricultural Motor Trials for Africa.—There will be held in Tunis, Africa, from April 15th to 22nd, a series of tests of agricultural motor apparatus which have been organized by the General Direction of Agriculture and Commerce of the Tunis Government. Under the head "Concours de Motoreulture," they will comprise tests of all kinds of motors, wagons, tractors and general agricultural vehicles. Prizes to the amount of $6,000 are offered for best performances. The tests are conducted by the Direction Generale de l'Agriculture, 76 Boulebard Bab Benat, Tunis, North Africa.

Promise for Four-Wheel Drive Tractors.—As a result of the tests of four-wheel drive tractors, which have just been completed by French army authorities, it is likely that the number of these vehicles in use in the army will be increased. Thirteen vehicles were tested and all of them proved remarkably efficient; there were no mechanical troubles. The rules of the competition required that four-cylinder motors be used and that carbureters operate equally well with gasoline, alcohol or benzole. Some of the vehicles showed as high as 40 ton-miles to the gallon of fuel. The average consumption of the heavy tractors was 1.3 to 2.2 miles per gallon of fuel; of the light ones, 3 miles to the gallon. The supreme test required that the tractors ascend a 22 per cent grade carrying their rated capacities; no trailers were hauled in this test. All of the vehicles ascended without trouble, though but one was able to remain stationary on the hill with only one set of brakes applied.

Remarkable Strength of Steel Wheel.—In a recent test of wire, wood and steel wheels conducted by the University of Michigan, the steel wheel came out with flying colors. It successfully withstood a lateral pressure of no less than 8,940 pounds to the square inch. The tests were made in a Riehl machine. The load increments, applied at the wheel rim, horizontally, were 500 pounds and the deflections shown were as follows:

DEFLECTION IN INCHES.

Load Pounds on Rim.	Steel Wheel.	Wire Wheel.	Wood Wheel.
500	0.001	0.001	0.013
1,000	0.041	0.030	0.033
1,500	0.055	0.120	0.075
2,000	0.068	0.215	0.121
3,000	0.099	0.425	0.210
4,000	0.110	0.533	0.312
5,000	0.143	.....	.....
6,000	0.233	.....	.....

The wood wheel failed at 4,500 pounds; two spokes in the wire wheel broke at 4,000 pounds, though no nipples pulled through the rim.

Astronomy

The New Comet Recently Discovered by Kritzinger in Germany has been observed by Dr. William R. Brooks, professor of astronomy at Hobart College, Geneva, N. Y., from the Smith Observatory. Its position on April 23rd was right ascension 17 hours 41 minutes; declination north 9 degrees 41 minutes, near the head of Serpentarius, with a daily motion of about one degree in a northeasterly direction. The comet is quite faint telescopic, a broad diffused nebulosity with slight central condensation and no tail. It is growing brighter, arriving at perihelion, or nearest to the sun, the last of May.

The Total Light of the Stars.—Dr. Chapman read a paper before the Royal Astronomical Society describing investigations made on the total light of the stars. The results show that the total light from the stars is about equal to that which would be given by 630 stars of the first magnitude. The light given by stars of each magnitude increased from the first magnitude down to the tenth, the decrease in brightness of the individual stars of the successive magnitudes being more than compensated for by the increase in the number of stars belonging to that magnitude. But below the tenth magnitude this is no longer the case, the light falling off more and more as we descend the scale.

A Meteorite from Zululand.—Prof. Stanley describes the fall of a meteorite in the N'Kandhla district of Zululand, which took place on August 1st, 1912. An explosion took place, which was audible over a considerable area, and a rapidly moving body was seen accompanied by a spiral trail of smoke and emitting a rumbling or crackling sound. The meteorite discovered by Prof. Stanley fell within a few yards of a native woman. It weighs nearly 38 pounds, and consists almost entirely of nickel-iron alloy, and is therefore classed as a siderite; it is coated with a skin of magnetic oxide exhibiting flow lines and shows numerous "thumb marks." An analytical investigation shows the presence of iron, nickel, silicon, sulphur, carbon, phosphorus, aluminium, magnesium, platinum and chlorine, the bulk of the meteorite being composed of iron.

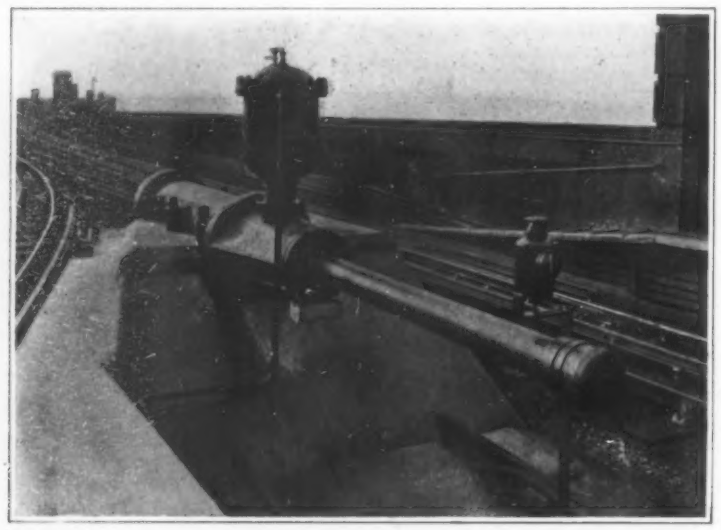
The Stability of the Solar System.—A law connecting the distances of the planets of the solar system from the sun has been discovered by Beldt, which is in close agreement with the observed facts. The mere existence of such a law throws light upon the stability of the solar system. A century ago Lagrange and Laplace thought they had demonstrated the invariability of the mean distances of the planets, and from that the stability of the solar system. But the mathematical series used in this investigation have been shown by Poincaré to be divergent, and therefore, so far as those calculations go, the stability is uncertain. If, however, the distances of the planets had been changed since the origin of the world by the action of the tides, their mutual attraction, etc., and if the perturbations so caused had accumulated, they would have been different for different planets, and no law connecting the distances of the planets and their satellites would have been discoverable.

Astronomical Telegrams.—The last annual report of the Director of Harvard College Observatory reviews briefly the telegraphic arrangements by which announcements of important astronomical discoveries and observations are given to the world. The distributing center in America is the Harvard Observatory; in Europe, the Kiel Observatory. A new object discovered in one continent is likely to be observed in the other on the following evening; hence the necessity for this prompt interchange of information. The expense of cabling American observations to Kiel is borne entirely by the Harvard Observatory. Cablegrams received from Kiel are generally distributed in this country by "night letter," and may thus be transmitted in ordinary language instead of cipher without increasing the expense. They are sent to all institutions and individuals who express a wish to receive them and who are to pay the telegraph charges from Harvard. During the year ended September 30th last, 33 telegraphic announcements were made, mainly relating to the discovery of comets.

The Shape of the Earth.—On the earth and on Mars the oceans dominate the austral hemisphere. This fact may be attributed to the translation of these two planets in a south-north direction across the primitive nebula. The rotation so set up would result in the production of cold currents which might cause the temperature to become inferior to 364 degrees, the critical temperature of water, and the currents would be such as to cause the condensation of the oceans to be produced round the South Pole, and to determine that the direction of the currents should be toward the equator, which explains the pointed form of the austral continents. The theoretical calculation of the velocities of these currents and the amount of solid matter transported by them is verified by direct measurement. Thus, 2,000 meters beneath the surface of the sea, the magnitude of the oceans is constant on the parallels of the austral hemisphere, and the magnitude of the continents is constant on the parallels of the boreal hemisphere.

Hydraulic Train Stops

THE sudden stopping of trains at terminal stations has long been a source of continual annoyance to travelers, and in many cases has been the cause of serious accidents. A train stop, or what is technically known as a "buffer," that will reduce the speed and concussion of the incoming train to a small fraction of resistance, has long been needed on most of our railways. A hydraulic buffer of very interesting design has been developed by a firm of English engineers. It will resist and stop trains without the slightest recoil, that may be running at speeds of from 6 to 10 miles per hour. It consists of one, or a pair, of cast-iron cylinders mounted upon a concrete foundation, and the front castings project forward, carrying the piston rod or rods. Each rod is fitted at its outer end with a buffer head. The cylinder is entirely filled with water, and passages are provided so as to permit the water to flow from behind the piston to the front as the piston makes the home stroke. These openings are very much larger at the front than at the back. As the speed of the train is diminished, and the recoil of the piston takes place, a lesser area is provided for the water. For this reason an almost constant resistance is provided, and the incoming train is stopped without the sudden shock usually experienced. A relief valve is provided in the front casting which takes care of the equivalent amount of water displaced by the piston. The resetting of the piston is done automatically by means of a constant supply of water which is brought to the front part of the cylinder at a pressure of about 35 pounds to



Oil buffer to stop trains without shock.

the square inch. This acts upon the area of the piston rod and immediately forces it into position again ready for the next train. The illustration shows an 8-foot oil buffer. This is operated entirely by oil, which is forced, after having accomplished the action of the piston in checking the train, into the receptacle shown on the front of the forward casting, and may be used over and over again. In this case the return stroke of the piston is made through the use of compressed air which is available on the line.

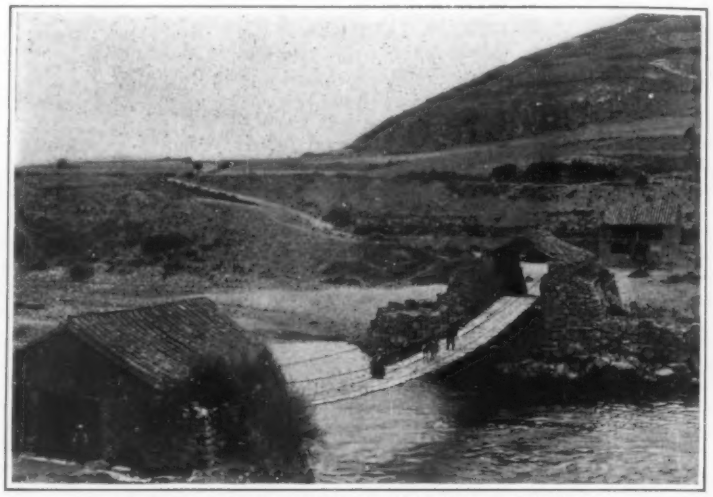
Building Dams on the Ice

THE Government engineers on the Upper Mississippi have found that by constructing the dams on the ice in the winter they can often build them in shallow places and across sand bars which are inaccessible to the barges and steamers in the summer months. The work also can be done much more cheaply. The willows and rock are hauled upon the ice by teams and unloaded at the place where the dam is to be constructed. The building crews follow the same method as is used in the summer months. A mattress of willows is made, loaded with rock, a second willow mat laid on top and so on until a dam of the proper height is constructed. When it is finished, the ice is cut away and the structure sinks to the river bed of its own weight. The work on the ice has been progressing for three years all along the upper half of the river. Less has been accomplished this year than usual because of the thinness of the ice.

Building a dam on a frozen stream.

Primitive Bridge Engineering in Peru

THE curious suspension bridge shown in the accompanying engraving was built by the native Indians of Peru. It may be found across the mountains from Lima, in the Huancayo Valley, near Jauja, spanning the Huari River. Being a mountain stream, subject to sudden torrential floods, substantial towers have been



Curious suspension bridge built by Peruvian Indians.

built at each side, which provide secure anchorage for the cables and raise the floor of the bridge well above high water. The floor is hung from the cables by means of diagonal, as well as vertical lines, so as to prevent the bridge from swaying lengthwise. Side sway is prevented by guy lines running from the center of the bridge to each side of the towers. The water under the bridge is on its way to the Atlantic Ocean, *via* the Amazon River. A journey of over 3,000 miles lies before it.

Obtaining Potable Water from the Muddy Colorado

AT the conception of the wonderful plan to divert the waters of the great Colorado River for the purpose of reclaiming the arid Colorado desert in California, no consideration was given the quality of the river's water. All that then concerned the adventurous engineers was to wet the thirsty land. Now that this has been accomplished and the famous Imperial Valley has blossomed into a land of immense agricultural activity, and half a dozen thriving towns have cropped up with an aggregate population of over 40,000, the problem of wetting the palates

Silt precipitated out of the drinking water of Brawley, California.

of these people has become a far more delicate undertaking than that of merely wetting the land. On its long winding course through the Grand Canyon country of Arizona the Colorado becomes supersaturated with a very fine silt, and this it carries on down into California and through the great Imperial Valley irrigation system, which covers an area of 350,000 acres. All the water used for drinking in the valley, both on the ranches and in the towns, has to be taken from the thick, chocolate fluid which runs through the big irrigating ditches.

When the water arrives at Brawley in the extreme northern end of the valley, it has a molasses consistency and an invincible flavor. The 3,000 inhabitants of the town of Brawley consume 200,000 gallons of this water daily. In order to prepare the ditch water for drinking, the town has a municipal water plant. There are several large reservoirs or settling basins where the mud in the water is at first allowed to precipitate, the clear water afterward being pumped into an elevated storage tank from which it gravitates through the city mains.

The settling basins were made by inclosing an area of ground 200 feet square with battered earth walls to a height of 12 feet. The full head of the ditch water is run directly into this until the water is 6 or 7 feet deep, after which the supply is cut down to the actual amount consumed by the people daily. At the end of the settling basin, farthest from where the ditch water is received, a small raft is anchored. This supports an open-end, vertical pipe which is submerged about 6 inches below the surface of the water. This pipe is connected with a main from the pump house, and conveys only the surface water of the settling basin which is usually very clear.

The accompanying photograph illustrates what a great amount of mud is precipitated in these basins. The view shows the bottom of one of them after the water was drained off. The man is standing on the original floor of the basin. The 30-inch deposit was precipitated during a period of twelve months.

X-Ray Moving Pictures of the Digestive Tract

A New Way of Studying Diseases of the Stomach

By Herbert T. Wade

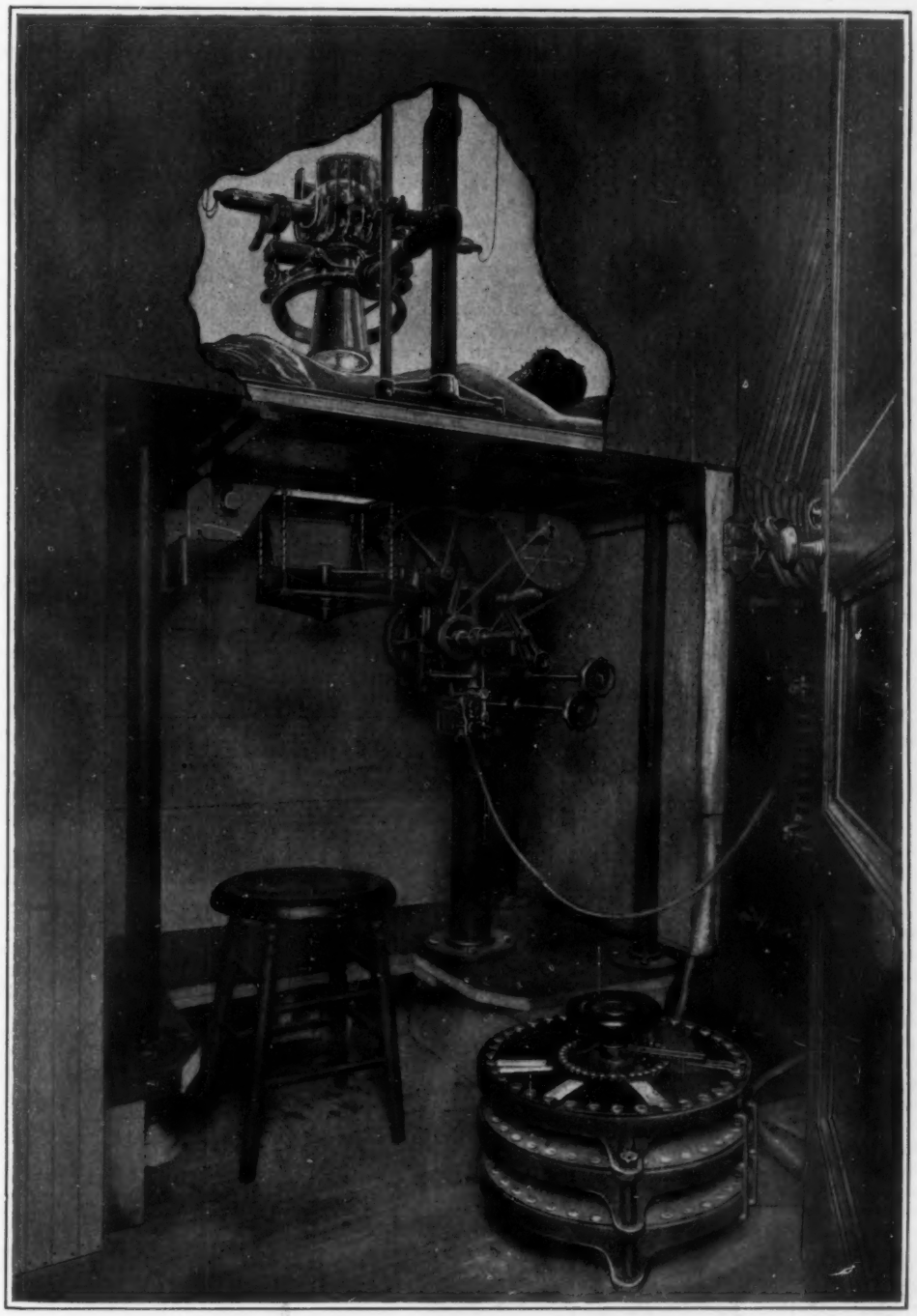
AMONG the recent advances of medical science none has been more marked and conspicuous than progress in treating the various diseases of the digestive tract, particularly those of the stomach and the intestines. This has been made possible in great measure by modern methods of diagnosis in which quantitative and positive results have been secured in various ways, one and not the least of which has been the study of the digestive tract by means of the Roentgen rays. With the development of improved Roentgen ray tubes and a better understanding of methods for their use and application, it was realized that by filling the stomach or digestive tract with material opaque to these rays and making a radiograph or shadow picture of such a fluid cast in relation to the adjoining organs, the progress of digestion could be studied. This accordingly was done, and to-day in diseases of the stomach and intestines it is quite usual to secure a radiograph or plate on which is recorded such a fluid cast of the stomach and intestines filled with the opaque substance, and then make a Roentgenographic diagnosis.

This opacity is obtained by a mixture of bismuth or barium and buttermilk administered to the patient under examination, and the progress of this material, as it passes from the œsophagus into the stomach and is acted upon by the stomach and then passes out into the intestines, can be studied. Hitherto it has been feasible to take such a radiograph only at various stages of the process, although since the development of motion pictures and motion picture apparatus the desirability of Roentgenokinematographs, or X-ray moving pictures of the stomach, made to demonstrate and record not only the condition, but its actual movements or gastric motor phenomena, has been appreciated and attempts at its realization made. As early as 1909 a series of successive Roentgenograms of the stomach were made by Doctors Kaestle, Rieder, and Rosenthal. Inasmuch as only thirteen of these pictures were made in 22 seconds, it was apparent that while a beginning had been made, with such slow speed true kinematography hardly could be attained, and the results were little more than an improvement on an ordinary series of Roentgenograms.

Recently, as the result of working on apparatus to make serial radiographs of the stomach and intestines, a special apparatus has been devised by a distinguished Roentgenologist, with which it is now possible to secure true moving pictures on an ordinary sensitized film at various stages of the digestive process at the rate of at least four exposures a second. Thus the churning effect in the stomach and the peristaltic or muscular action in the intestines by which the contents of the alimentary tract are advanced, after being duly acted upon, can be studied by means of motion pictures, which, when reproduced, graphically show by the movement of the silhouetted image the action that is taking place.

This new method has been made possible in large part by the new Coolidge Roentgen ray tube described in the SCIENTIFIC AMERICAN of February 21st, 1914, which secures in its operation greater stability and evenness of penetration as well as susceptibility to more accurate regulation, thus giving more even radiographs.

The apparatus for making the moving pictures consists of the usual lead-lined table in a dark booth with the Roentgen ray tube above in the usual position and the customary rotary transformer, or other devices, for its exciting, along with the special mechanism for securing the movement of the film and the periodic exposures. The patient is placed on the table, face downward, with the Roentgen ray tube directly above the stomach. There is a square opening in the table beneath, across which, through suitable guides, the film passes, being wound from one spool to another, as in an ordinary film camera. This film is eight inches in width and is supplied on spools which, as at present constructed, are capable of 25 or 50 exposures. Directly beneath the film is located an intensifying screen coated on its upper side with calcium tungstate, a fluorescent material that glows brilliantly when excited by the Roentgen rays striking its surface. Naturally, when the rays from the tube in their passage through the body encounter any body or substance opaque to them, as a bone, there will be a corresponding shadow on the fluorescent screen, and the variation in intensity of the shadows of different organs, or material, of course is the basis of the whole operation. The actual effect of the intensifying screen is to emit actinic light under the influence of the Roentgen rays from the tube above. The film itself is not acted upon directly by the Roentgen rays, but by the rays which are sent out from the fluorescent screen. A second fluorescent screen, with its lower surface coated, located directly beneath the first, may be observed by the operator either directly or by means of an inclined mirror. In this way the position of the patient can be arranged so that the stomach can be centered on the film, and, at the same time, the action of the apparatus observed. The operator or the diagnostician can observe the process fluoroscopically and need not start the film in motion until the desired stage is reached.



Apparatus for taking moving pictures of the stomach.

The film has at its edges regular perforations to engage studs correspondingly placed on the circumference of sectors connected with the driving mechanism so that it may be moved regularly, but intermittently, across the opening where the shadow falls. The apparatus is arranged so that six exposures a second may be made, and the exposure takes place automatically when a fresh section of the film is placed at the opening. The mechanism operates by means of shafts and appropriate gearing, and there is arranged in connection an electric switch that works automatically in conjunction with the advance of the film, closing the circuit of the transformer supplying the alternating current, and lighting up the tube instantaneously as each fresh surface of the film is brought in position. Accordingly, there is a regular series of exposures of the shadows produced on fresh surfaces of the film and the phenomena occurring in the stomach and intestines can be observed and recorded. In this way, when the film is developed a series of pictures is obtained where the various exposures can be studied both individually and collectively in connection with one another, or they may be reduced by ordinary photographic methods for reproduction in the usual motion picture projection apparatus. The time of the passage of the film can be controlled by the operator and other adjustments made so that the exposures following each other in regular succession make possible a study of the peristaltic action, which is a regular and involuntary muscular contraction of the stomach, or intestines, with a period of from 15 to 20 seconds in the case of the stomach. Not only do these motion pictures enable some definite idea to be formed of the peristaltic action taking place in the stomach, but they promise in the future to put at the disposal of the diagnostician, or investigator, additional information regarding peristalis in the pylorus, or lower opening of the stomach, as well as in the upper part of the small intestine, or duodenum. Some twenty-five exposures can be made of

a single antrum, and sharp and interesting pictures can be obtained.

The mechanical arrangement is indicated in the accompanying illustration, which shows the apparatus as arranged in a modern Roentgen ray laboratory. The operation is practically automatic. Once the patient is in position and the instrument adjusted, a fluoroscopic observation first is made visually, and the film can be rapidly unreeled and the exposures made. After development the diagnostician has a record of the condition of the gastro-duodenal tract, or the film may be reproduced reduced in size and made available in an ordinary motion picture projection apparatus, so that the record may be thrown upon a screen and the actual motion studied, synchronized to the original time of occurrence. Moving pictures have been applied to a greater or less extent in the study of disease and diagnosis, but this is believed to be the first satisfactory attempt at using them in connection with the Roentgen rays and with a special and efficient form of apparatus.

A Huge Dipper Dredge for the Panama Canal

UPON the cover of the present issue we show the huge dipper of one of the two large hydraulic dredges which have recently been completed for the Panama Canal. The dipper can take up at a single scoop, 15 cubic yards, or say about 20 tons of material, and its huge proportions can be realized from the fact that it has held a group of thirty-four men, standing upon a platform built for the purpose when the photograph was taken.

The two dredges, which are known as "Gamboa" and "Paraiso," have been built at the yards of the Staten Island Shipbuilding Company. Each dredge displaces about 1,500 tons, and each, in addition to its 15-cubic yard bucket, has one other of 10 yards' capacity. It is expected that when in regular service the two dredges together can take out about 600,000 cubic yards of material per month.

The 15-cubic yard dippers have been built with massive manganese-steel lips and dipper-door hinges of forged steel which are 6 by 10 inches in cross section. The dippers are 10 feet 9½ inches in height from the bottom band to the upper edge of the lip. They are hung on a 3¼-inch, single-part, wire rope, hoisting cable. The dredges can dig to a depth of 50 feet below the surface of the water.

The dipper handle is 72 feet long, with top and bottom bars measuring 2 inches by 12 inches in cross section. The weight of the dipper handle is 81,000 pounds.

The dipper boom is 62 feet long, weighs 113,000 pounds, and is of plate-girder construction. The pins for the sheaves on the boom are 11 inches in diameter, and the parts are larger than any built before for this purpose.

The main hoisting machinery consists of horizontal, twin-tandem, compound, condensing engines, with cylinders 16 and 28 inches in diameter by 24-inch stroke. The engines are compound geared to heavy spur gears about 12 feet in diameter. These gears are mounted on each end of a 16-inch main hoisting shaft which carries the cast steel drum.

There is an independent 12- by 16-inch engine of the link-reverse type for operating the swinging machine.

The spuds at the forward end of the dredge are of unusual size, being 4 feet square and 72 feet long. They are built with cast-steel diaphragms, 5 feet apart, and continuous 10-inch I-beams in the middle of each side plate for its full length. The maximum reaction on the spuds when the digging takes place over the side of the dredge is about 700,000 pounds. The spuds are placed sufficiently far back from the front of the dredge to make possible a swing of 180 degrees.

The Current Supplement

THIS week's SUPPLEMENT brings the concluding instalment of P. W. Bridgman's report on his researches on the properties of water and ice at high pressures.—A working model for demonstrating the effects of vegetation as a check to erosion is illustrated and its construction is described.—W. P. Dreaper writes of the research chemist in his relation to the textile industry.—A discussion on the sintering of iron ore, which took place at a recent meeting of the Engineers Society of Western Pennsylvania, is reported.—The erosion of canal bottoms by the action of boat propellers has caused much trouble. Prof. O. Flamm has devised means of preventing this, which are described.—F. C. Perkins writes on electrically operated tools.—The third of Sir J. J. Thomson's lectures on Recent Discoveries in Physical Science appears in this issue.—H. Guenther describes the Electro-cardiograph and Its Use.—C. H. Townsend tells us how a school of five live porpoises was brought from Cape Hatteras to the New York Aquarium.—F. R. Moulton gives a popular exposition of the solution recently found by Karl F. Sundman for the classical problem of three bodies.

An Innovation in Ship Salvage

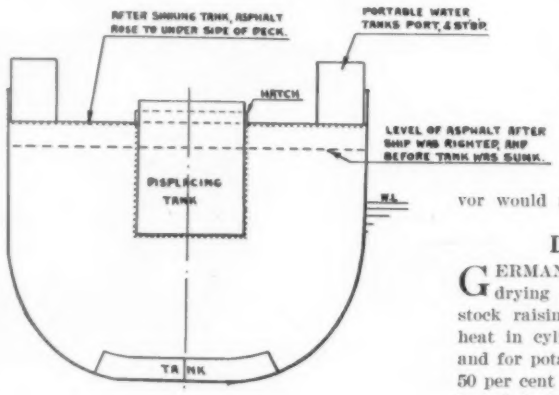
By Robert G. Skerrett

THE salvage of a steamer in grave peril because of a shifted cargo was accomplished a short while ago in a decidedly unique manner. The performance incidentally shows us the naval architect from an unusual angle and, incidentally, illustrates the advantage of technical training when applied elastically.

The craft in danger was a Danish freighter, the steamship "Berlin," bound from Trinidad, with a cargo of nearly 3,000 tons of crude asphalt, and on her way to New York city. The asphalt was from a new lake, and seemed even at the time of shipping to be somewhat more plastic than the usual run of that substance. It was stowed in the ship's regular cargo space, and aft the hold was divided longitudinally by a center-line bulkhead. However, there was no reason to expect trouble, and all went well until the vessel was some distance on her journey; but then the mischief began in earnest.

Suddenly from the northeast the "Berlin" encountered a heavy gale, and for days the wind blew fiercely, and the seas rose higher and higher as she nosed her way along through the Gulf Stream. She had to slacken speed, but with a sound hull and well-secured hatches there was no apparent cause for alarm. However, the warm waters of the Gulf Stream had been working unnoticed upon the cargo of asphalt, slowly heating it through and making it fluid. Somewhere north of Bermuda the "Berlin" was hit by three exceptionally heavy seas, one after the other, and without any warning the craft quickly heeled over to an angle of 21 degrees and staid there! The surging asphalt had broken the center-line bulkhead away from its fastenings top and bottom at the after end, and this had allowed the cargo to shift.

The vessel seemed in imminent peril of turning turtle,


AFTER SWING TANK, ASPHALT ROSE TO UNDER SIDE OF DECK.
PORTABLE WATER TANKS PORT & STBD.
HATCH
LEVEL OF ASPHALT AFTER SHIP WAS RIGHTED AND BEFORE TANK WAS SUNK.
DISPLACING TANK
W.L.
TANK

SECT. AT AFT. HOLD

and something had to be done, and done quickly. The engineer's force began the toilsome work of removing the coal from the listed bunkers, while the deck crew and the navigational officers went at the desperate task of trying to secure the upper edge of the ruptured bulkhead. By almost superhuman efforts, lasting well nigh for twenty-four hours, this was effected, but nothing could be done to catch and hold the lower end of the partition. After a fashion, the ship was righted somewhat, but there was still a menace in that loose bottom of the bulkhead.

As the ship rolled toward the side where the bulkhead plating should have been fastened, the partition gave somewhat like a pump leather and allowed the asphalt to surge through the opening toward the listed side. Again, when the ship rolled oppositely, the plating closed the breach and kept the asphalt from flowing back again. Thus, the motions of the vessel and the flexing of the bulkhead acted just like a pump, and raised the level of the threatening fluid four feet higher on one side than on the other. Fortunately, the deck and the hatches held, although the ship had a serious list, and, after an exhausting struggle, the "Berlin" made harbor at Cape Lookout, North Carolina. Her further relief had then to come from regular salvors.

A New York salvage concern that has done some rather remarkable work was asked to bid upon the job of sending a relief vessel to take off a thousand tons of the "Berlin's" cargo, and, together with the Danish craft, to bring both vessels to New York. The asphalt was then far from fluid enough to be pumped out, and to remove by digging would have been a long and a very toilsome, not to say expensive, undertaking. The salvors wanted an easier solution of the pending problem, and just at this stage Mr. R. H. M. Robinson, lately a naval constructor in the United States Navy, was called into consultation. It did not take Mr. Robinson long to figure out that two wooden tanks, one on each side of the upper deck, 5 feet wide and 100 feet long, would hold double the amount of water ballast necessary to trim the ship to an even keel against the listing moment of the unstable cargo. To prevent surging, each tank was subdivided into three compartments, and 131 tons of water were sufficient to right the craft when this ballast was put in the tank on the high side. The idle tank was held in reserve to meet any emergency should the asphaltum shift to the opposite side *en route* to New York.

But this was not the entire solution of the difficulty, and to Mr. C. P. M. Jack, another naval architect of New York, credit is due for the clever means by which the cargo was made to fill the entire hold up to the under side of the deck, and was thus held in place so that it would have no chance to shift again. In one of the big hatches a tank was fitted and loaded until, in sinking, it displaced the asphalt. A crude stuffing box was made out of the cargo hatch coaming, and the displacing tank thus became a weighted hydraulic plunger free to move up and down and to absorb strains that would otherwise have been transmitted to the covering deck.

According to the previous estimates, and counting upon removing a thousand tons of the cargo, it was clear that many days would have been required to get the ship on an even keel again and ready to resume her run northward. But even so, with that work done, there would have been no certainty that the remaining cargo might not have caused more trouble. By the adopted method it took just three days to build the tanks of wood and to fit them in readiness for service. The tanks were made of heavy planking lined with tarred paper, and the displacing tank was loaded with bags of sand, sand being a readily obtained material of nature's providing down on the Carolina coast. From the time the salvors started southward from New York until the "Berlin" reached the metropolis under her own steam was a matter of just eleven days.

But for the naval architect's few minutes of figuring, by which he determined how much deck weight moved laterally would be needed to effect the change of trim desired, many days would have been lost in following the usual procedure in digging out that difficult cargo. Time was saved, money was saved, and a unique remedy was evolved, which may have many practical advantages in meeting kindred conditions in the future. The ordinary salvor would not have thought of this expedient.

Dried Yeast as a Cattle Food

GERMAN breweries are going into the question of drying yeast with a view to producing food for stock raising. Such yeast is dried at a rather high heat in cylinders, such as are used for milk powder and for potato drying. The dried yeast contains about 50 per cent of albuminoid matters and forms a concentrated food which can be used to good advantage for most stock when mixed with other foods, and is relished by cows, sheep and horses. With cows, the percentage of butter in the milk is increased, and for horses it is said that half the grain is economically replaced by mixed dried potatoes and dry yeast. Within three years the number of yeast-drying plants increased from 5 to 26, counting 11 in Germany. It is now introduced for human food, but in this case the yeast is freed as much as possible from the bitter principle due to the hop. Such prepared food is said to be easily digested and assimilated, and Völtz and Baudrexel showed that its value is three times its weight of moderately fat meat. It not only serves for food, but acts very favorably on nutrition owing to the lecithin contained in the proportion of about 2 per cent. According to Hayduck the product, even though it costs $0.60 per pound, costs less than meat for equal food value. It is probable that the price will be lowered when it is produced on a large scale, and no doubt it will be frequently employed in the food industries as a very economical source of albuminoid substances.

Uncorking a Bottle

IT often happens that in attempting to uncork a bottle, the stopper is forced into the bottle instead, and it thus floats on the liquid. This would perhaps not be a drawback were it not that each time the bottle is to be emptied the cork comes to the neck and causes an obstruction, preventing the flow of the liquid. This can be avoided very readily, and all that is needed is to bend a piece of stiff iron wire in a long U-shape, properly fitting it in the neck of the bottle so that the loop portion projects somewhat below the neck. Upon overturning the bottle, the wire loop prevents the cork from reaching the neck to obstruct it.

Gamma Rays Produced by Roentgen Tube

ACCORDING to a special cable dispatch to the SCIENTIFIC AMERICAN, Director Dessauer of the Veifa X-ray Tube Works, Frankfurt a. M., has succeeded in producing highly penetrating rays similar to the gamma rays of radium, by means of focus Röntgen tubes.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Urgent Need for an Increase of Our Navy

To the Editor of the SCIENTIFIC AMERICAN:

In the admirable series of articles which you are publishing in the SCIENTIFIC AMERICAN on the "Problem of the Navy" you published two tables, one of personnel of the three leading navies, and the other naval tonnage, built and building, 1913. I would request that you publish the following tables brought up to January 1st, 1914, for the five leading naval powers. The joker in the naval tonnage, built and building, is the large loans which France, Japan, and Germany are making for new construction, and which do not appear in the ordinary naval estimates, thereby lulling us to sleep under a false apprehension. These tables are not attractive, but they will bear careful study by any one who is really interested, and are very illuminating. The one thing we all fail to grasp is that the pre-dreadnought battleships and armored cruisers must soon be passed out and their place taken by dreadnoughts. The proposition to convert the only five scout cruisers we have, viz., the "Chester," "Salem," "Birmingham," "Minneapolis," and "Columbia" into fast merchant vessels for commercial purposes is fantastic, unless we recognize the necessity for building up-to-date scout cruisers with 4 inches of side armor and 28 knots speed, similar to those now building abroad. We are woefully lacking in torpedo boat destroyers, but the type we are now turning out, if made a little smaller and cheaper, would be ideal. The only reason the tonnage has been increased is that in the absence of scout cruisers, of which we have practically none, no one needs to be a prophet to see that torpedo boat destroyers will, in case of war, be used as scouts, for which they were not intended, and we will be without destroyers for the protection of the fleet.

The tables are as follows:

TABLE I.

NAVAL TONNAGE BUILT AND BUILDING JANUARY 1, 1914.

Item.	Great Britain.	Germany.	United States.	France.	Japan.
(1) Naval appropriation	$235,213,498	$112,037,576	$140,736,526	$122,493,753	$74,383,783
(2) Amount voted to new construction	77,662,162	53,240,546	35,326,695	63,655,515	26,278,631
(3) Percentage devoted to new construction	33%	47%	25%	44%	54%
(4) Resultant new construction in tons	538,580	284,870	161,842	230,264	204,900
(5) Total tons already built	2,052,711	943,338	760,002	645,891	497,199
(6) Total of (4) and (5) tonnage built and building	2,591,291	1,228,208	921,844	876,155	702,099
(7) Dreadnoughts and battle cruisers built	27	17	*10	2	3
(8) Dreadnoughts and battle cruisers building	15	9	4	9	7
(9) Capital ships, new (dreadnoughts)	42	26	14	11	10
(10) Pre-dreadnought battleships on hand	40	20	24	18	13
(11) Pre-dreadnought armored cruisers on hand	34	9	11	20	13
(12) Unarmored cruisers built and building	82	44	14	10	14
(13) Torpedo boat destroyers built and building	187	142	62	86	56
(14) Submarines built and building	94	36	51	93	15
(15) Coal colliers	1	2	11	1 (small)	0
(16) Coal and oil colliers, or oil only	12 (small)	0	13 (large)	1 (small)	0
(17) Supply ships	0	0	5	1 (small)	0
(18) Ammunition ships	0	0	1	0	0
(19) Repair ships	3	0	2	1	0
(20) Hospital ships	2	0	2	0	2
(21) Transports	0	0	5	1 (small)	0
(22) Mining ships	7	4	1	2	1

* This includes the "Michigan" and "South Carolina" as dreadnoughts.

TABLE II.

PERSONNEL OF NAVIES, JANUARY, 1914.

	Great Britain.	Germany.	United States.	France.	Japan.
(1) Total number of flag officers allowed	93	40	18	45	67
(2) Total number of captains and commanders	683	356	207	360	259
(3) Total other line and engineer officers	3,825	2,852	1,549	2,022	2,831
(4) Total warrant officers	2,693	2,686	867	2,445	1,553
(5) Total line, engineer and warrant officers	7,294	5,934	2,641	4,872	4,710
(6) Total enlisted men	115,208	60,920	49,854	60,505	43,847
(7) Ratio of enlisted men to line, engineer and warrant officers	1 to 16	1 to 10	1 to 19	1 to 12	1 to 9
(8) Marine officers	471	169	345	.....	.....
(9) Enlisted men (marines)	21,033	5,597	9,921	.....	.....
(10) Total medical officers	593	322	314	394	373
(11) Total pay officers	685	267	231	219	362
(12) Total naval constructors	118	159	75	175	143
(13) Total chaplains	151	28	24	.....	.....
(14) Total officers and men	145,553	73,396	63,413	63,859	49,435

COMMENTS ON THE ABOVE TABLES.

Items (1), (2), and (3).

France has raised a loan of eighty-one million dollars for new construction, of which $28,092,665 has been added to the regular annual appropriation of ninety-four millions for the year 1914. Japan has also raised a loan, or provided by taxation, for $78,837,569 to be added to the regular annual appropriation for 1911 to 1917. Since 1900 the German government has raised annual loans to meet the extraordinary extension of naval expansion amounting now to about $220,000,000. Not only is the present generation not finding this money, but also the interest on the loans, and the annuities for the repayment of these loans do not appear in the naval estimates in any form. Consequently the actual expenditures of Germany are far higher than appears in the estimates here given. Therefore, in the above table, Great Britain and the United States are the only governments which are not contracting loans for naval extensions. Germany has a fixed programme whereby in 1921 she is to have a fleet of 41 new dreadnought battleships, 20 armored cruisers, 40 light cruisers, 144 destroyers, and 72 submarines. The fixed charges which each country has to meet each year to merely maintain what navy they have without providing for new construction is about—Great Britain, 158 million; United States, 105 million; France, 66 million; Germany, 52 million; and Japan, 48 million. In the three last-named countries they have "conscription" and the pay is very, very small.

Items (4) to (15).

Items (4), tons of new construction, and (8), dreadnoughts building, show that the United States is on the toboggan slide to fourth or fifth place. The 25 per cent of item (3) shows this also. It is idle to fall back on items (10) and (11) of old ships which we had before the era of the all-big-gun ships. People with automobiles of the vintage of 1900 are living on the side streets. Other countries about crushed by taxation are raising taxes to catch up and get in the game. We alone are hypnotized by political oratory and self-complacent bumptiousness. Needed, immediately, a Council of National Defense, and a loan of $100,000,000 to increase the number of officers and men, build 10 battleships, 20 light cruisers for scouts, 36 torpedo boat destroyers, and 25 submarines.

Items (15) to (22).

It will surprise many people to learn that our Navy is the only one which has developed a fleet of auxiliary ships of special design for supply and service of the fleets in time of peace, ready for war. Other navies rely on chartering in time of peace, and buying and chartering in time of war the necessary merchant ships to carry coal, oil, provisions, ammunition, marines, and the sick.

Our new repair ships are superb, but we are lacking hospital ships. We have been quietly accumulating these ships, and may now stop, provided we build colliers of the same type for the service of the Panama Canal, or build other ships to run as merchant vessels in time of peace, as proposed by Senator Weeks for our now inadequate scout cruisers (we only have about five in all). The questions of any further auxiliaries, except two new hospital ships, should be taken up as a passenger and freight service in time of peace. The two hospital ships owned by Japan are regularly run between Nagasaki and Shanghai in time of peace as passenger vessels.

The mine ships of foreign navies are necessary because in all other navies than our own the coast and harbor defense is under the navy. With us it is under the Army. The one mine ship we have in the Navy is for the protection of the fleet. NAVY.

U. S. S. "Michigan," *en route* Vera Cruz, Mexico, April 21, 1914.

Mobilization and a Naval Reserve

To the Editor of the SCIENTIFIC AMERICAN:

The article, No. VIII, "Mobilization and a National Naval Reserve," in the April 18th issue of the SCIENTIFIC AMERICAN, is one of the ablest articles dealing with our great national need which has ever been published. It should be read and studied by every member of our Congress, and by every constituent.

That nation which can best guarantee its own peace and protection is the one best prepared for war. The cost of preparedness is but a fraction of the cost of war to a nation unprepared.

Do not our people realize that all the other great nations are quietly and grimly preparing for war in spite of peace conferences.

Your article was patriotic, highly commendable, and unless we awake, will prove equally prophetic.

Daytona, Florida. L. M. DRAKE.

The Perils of Electricity

To the Editor of the SCIENTIFIC AMERICAN:

I am sending you the following excerpt from the editorial columns of a local paper, thinking that you might be interested in hearing of the great peril in which the world is placed:

"This matter of handling electricity is getting to be a dangerous thing. At Madrid, Spain, Senor Igelsias recently 'lighted and extinguished at will fifteen electric bulbs at a distance of 600 yards.' It is also claimed that in February William Marconi lighted an electric bulb at a distance of six miles, by a wireless current. Electricity to do this must be very powerful. In the hands of a villain, electricity may yet be so used as to set whole cities on fire, kill individuals at will without being liable to even the least suspicion. And if individuals can be slaughtered, why not entire armies and whole communities? One cannot tell where all this will end."

After much careful consideration the only remedy which I can see is that we who have enemies who are electrically inclined refrain from carrying around with us in our pockets receiving plants strung up in series with a pound of dynamite. I realize that this would be a great sacrifice, and yet, for the sake of the world, we should do it. OSWALD C. BREWSTER.

Boulder, Colo.

Centrifugal Force Versus Screw Lift

To the Editor of the SCIENTIFIC AMERICAN:

Every little while someone brings out an invention in which a propeller is to be run in a hood or tube, although it has been well established that better results and higher efficiency can be attained by running the propellers in the open. Only last year one of our most prominent aeroplane builders was experimenting with propellers in his research laboratory, with the aid of a wind trunk; and he was quite undecided whether to run inclosed propellers or to place them in the full-sized wind passage.

Several years ago the writer was experimenting with centrifugal pumps, and while at work with his first model had an experience so unexpected, and that was so baffling as to fix it in his mind as a lesson well worth remembering. He would like to pass it along, and trusts that it may not prove unprofitable reading to you.

The pump model was exceedingly simple; being a piece of shafting about 2 inches in diameter by 15 inches long, deeply threaded with two opposed screws similar in appearance to the screws of a meat chopper. The screws were equal in length and pitch and were right and left hand. A space was cut out in the central part of the shaft, the intention being to have the screws pump toward each other, thus equalizing the end thrust. This opposed screw shaft was run in a well fitting hard brass tube that had an outlet delivery at its center and adjacent to the space in the shaft between screws.

You can imagine my surprise when I found that the submerged twin screw could be driven at a very high rate of speed; probably it was turning at from 3,000 to 4,000 revolutions per minute, and yet the water was practically at a standstill, surging slowly up and down about three quarters of an inch in height in the outlet tube.

After considerable study I reached the conclusion that the screw lift was nearly balanced by the centrifugal force, and its reflex action against the inflowing water. No doubt viscosity and adhesion played an important part, yet for want of time I was unable to experiment in that line. My defeat, however, pointed the way to balanced and opposed screws or scrolls that operate in parallel planes of centrifugal action.

Later experiments would indicate that any centrifugal pump could be reversed in rotation, and running in that manner would pump a little; this proves to my mind that centrifugal force, when aided by adhesion and viscosity, is greater than screw lift at the same radius and speed. WALTER A. SIMOND.

Franklin, N. H.

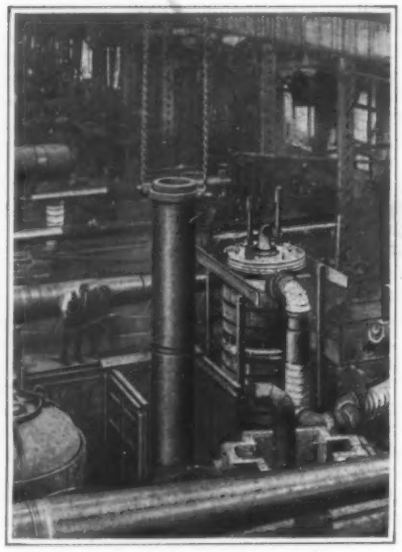
Making the Navy's New 14-inch Guns

By Louis E. Browne

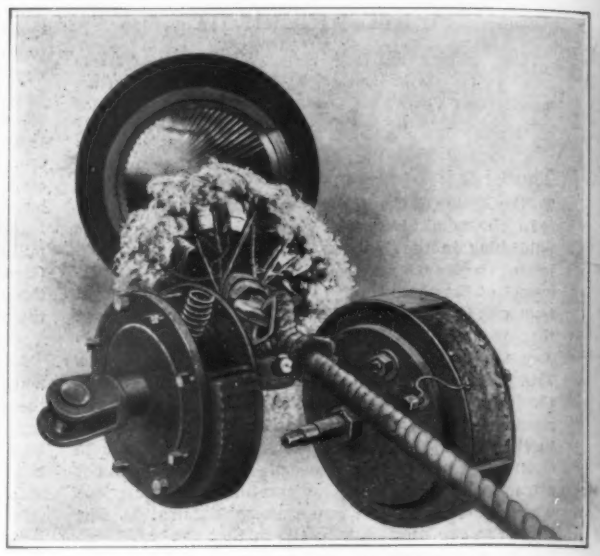
ON Sunday, April 26th, there sailed to Mexican waters the new dreadnought "New York," which was recently completed at the New York navy yard. She will be followed in a few days by the sister ship "Texas." The delivery of these ships to the Government will mark an epoch in naval construction, for they will be the first ships to mount 14-inch guns. These ships will be by far the most heavily armed in the world. The ten 14-inch rifles are arranged in pairs in five turrets, all of which are upon the ships' center lines. This design, adopted by the Navy several years ago, enables every gun in the main battery to fire on either broadside.

Experiments with the 14-inch rifle began in 1900, and it was adopted by the United States Navy as its standard big gun late in 1906. Like the 12-inch rifle, the new guns for the dreadnoughts now building are of the built-up type, consisting of the tube, or lining, jacket and several hoops. No single casting could withstand the enormous stresses resulting from a modern firing charge. The guns are built in parts and shrunk together to give vastly greater strength.

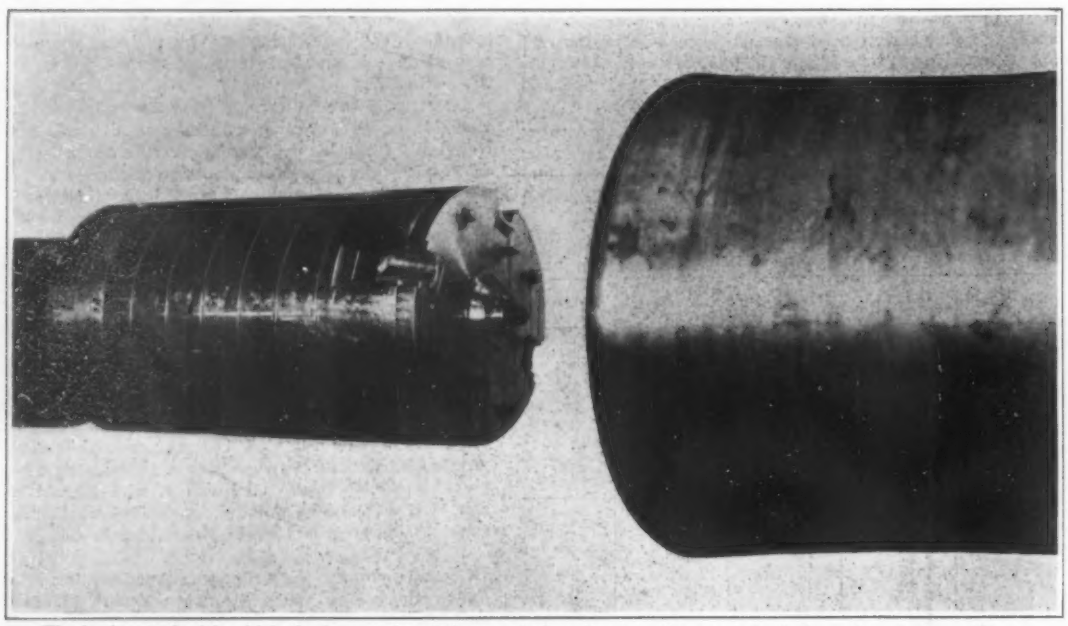
The Navy requires steel of the highest grade of perfection for the new guns. An increase in the principal properties of malleability, ductility, hardness, toughness, tensile strength, and elasticity was desired. While not greatly superior to the steel used in the 12-inch guns, the metal which goes into the new 14-inch rifles is slightly superior. A steel containing something more than three and one fifth per cent of nickel was selected. The Bureau of Ordnance requires that all steel gun



Lowering the heated chase hoop over the liner, upon which it will shrink in cooling.



Three tools for removing burrs and polishing the rifling of the gun.



The boring tool with which the inner tube of the gun is bored out to the exact final dimensions before rifling.

castings be made by the Whitworth and open-hearth method. The molten metal is poured into a special mold and compressed by hydraulic action applied to rams. A pressure of more than 6 tons per square inch is used to get rid of blow-holes and to obtain a metal of high density. This method also prevents "piping" and segregation of the various constituents, such as sulphur, phosphorus, and manganese.

The ingots are carefully reheated and forged to about one half of their original size. This operation, according to naval requirements is performed after the casting has been rough-drilled through its longitudinal axis. After forging the castings are gradually re-heated and annealed. They are again heated, treated to an oil bath, and re-annealed. The castings are now ready for delivery to the Naval Gun Factory in Washington. When received there the castings are given exhaustive tests, and if found wanting, returned to the foundry as scrap.

As the forgings are rough-drilled in the private foundry they are ready for rough-turning when received at the gun factory. They are carried to the lathes by traveling cranes. The breech end is gripped by several large jaws on the face plate and the muzzle end is gripped by a "pot-center," a large iron ring having several arms screwing radially through it. Thus the forgings are held upon live centers.

The operation of turning is comparatively simple. Often as many as four or five tools are used at the same time, requiring two or three carriages. Tools 1½ inches wide are used for finishing, and there is no difficulty in keeping the measurements within 0.001 of an inch.

Boring requires much greater care than turning; for the action of the drill, or cutting tool, cannot be observed. Three cuts are usually required to bore the tube and hoops. For the first cut a hog bit, a half cylinder of iron with a steel tool protruding from its end, is used. The other cuts are made with a packed bit, a wooden cylinder with an ordinary cutting tool. The wooden cylinder is slightly larger than the hole cut by the tool. This insures an even, true cut. When bored, the tubes, jackets, and hoops are ready for assembling, that is, shrinking together.

The tube, which is slightly tapered to render easier its extraction after it has been worn out by firing, is lowered into the shrinking pit, breech-end up. It is connected with water mains and cold water is allowed to circulate within it. This keeps its temperature normal and assists in cooling the jacket. The jacket is next lowered into the hot-air furnace, which is a vertical cylinder of gigantic proportions made of fire brick and asbestos. It absorbs heat from hot air, which has been passed over petroleum burners in pipes. The hot air enters the furnace at the bottom, circulates about the casting and is drawn out at the top to be reheated.

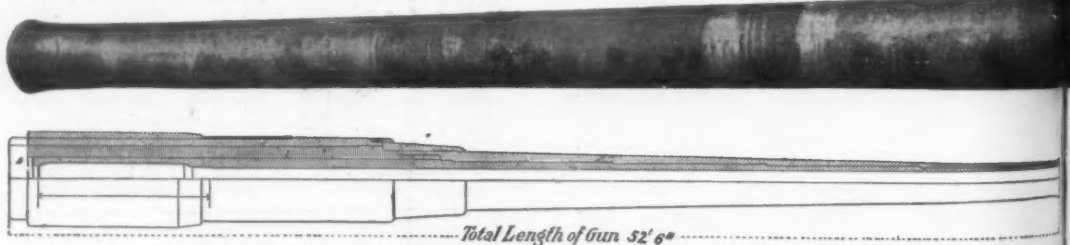
Because of the immense size of the jacket it takes more than thirty-six hours to raise the temperature of the metal to 700 deg. Fahr., which is the highest temperature to which this metal can be raised without changing its form in any way. The jacket is taken from the furnace by the crane and carried above the shrinking pit, where it is heat-tested. Metal strips, which have melting points between 400 and 600 deg. Fahr., are passed over every foot of the jacket. These are extremely efficient thermometers. Guided by men with asbestos gloves and huge tongs, the jacket is lowered over the lining, or tube, to the required position. A cold water spray is directed against the points in the jacket where it should first cool. The remainder of the jacket cools unassisted. Should the jacket jam, it is immediately hoisted off, allowed to cool, the abrasions filed off and another trial made. When cool, the tube and the jacket, which have been firmly shrunk together, are hoisted out of the pit and carefully measured. The tube is gaged to determine how much compression has resulted from the operation.

Why guns are built in parts and shrunk together is easily explained. Steel is elastic. It will withstand a certain pressure, stretch so much, and return to its normal condition. When the pressure is too great it stretches beyond its limit of elasticity and breaks. If this same steel can be compressed from without it will then require a force equal to the limit of elasticity of the steel, plus the value of the pressure causing compression of the steel, to break or permanently strain the steel.

In shrinking the tube, the jacket and the hoops together this compression is attained. Thus, to burst a modern gun it requires a force equal to the strength of the steel plus the compression.

In each case the outer hoop is heated and slipped over the inner one. In the operation described above the inner diameter of the 14-inch jacket when cold is always a little smaller than the outside diameter of the tube over which it is shrunk. The jacket is expanded by heat. It slips over the tube. When it cools it contracts and compresses the tube, making it slightly smaller than it was before. The amount by which the diameter is decreased is called the compression. The jacket is also slightly enlarged by the process, but not beyond its limit of elasticity, so that it always retains the tendency to return to its normal position.

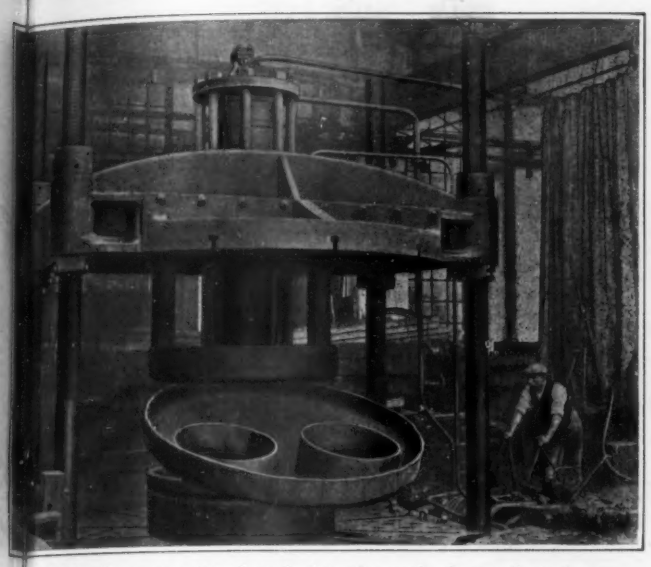
It was found, especially in making the large gun, that it was much easier to bore the jacket and hoops first and to adjust the others parts to them than it was to try and fit the great inside boring to certain castings. The jacket fits over the breech half of the gun. The chase hoop fits over the muzzle half. By the same process the chase hoop is shrunk on next to the jacket. A locking hoop is next shrunk on over the joint of the jacket and chase hoops. Five smaller hoops are shrunk on the 14-inch gun before it is ready for finishing.



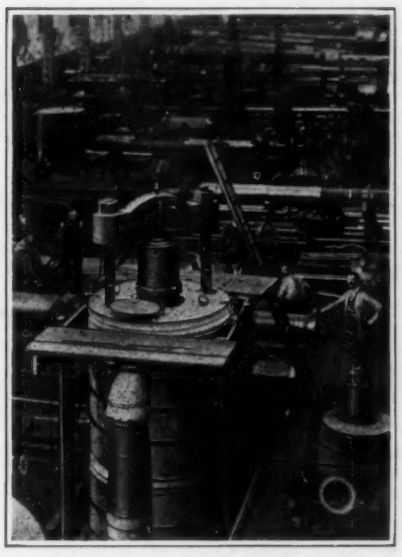
The new Navy 14-inch gun, showing the method of building up by shrinking on hoops.

The gun is carefully drilled or bored and turned in the great lathes. The muzzle is finished by hand. The screw box is made in a collar. Formerly it was made in a jacket. This renders possible a change of screw box should the threads of the breech become worn. The collar fits tightly against the jacket and tube. This prevents the tube from moving to the rear.

Rifling gives the shell a rotary motion about its axis, which tends to keep its axis in the true line of flight. Rotation of the



The hydraulic press enters largely into the work of manufacturing the 14-inch gun.



The chase hoop shrunk on and held in place during cooling by 500-ton jack.

xing pit, g points t of the ided by lowered A coil jacket jacket ediately and an- jacket, ted out aged to om the s easily in press ndition ts limit e con- qual to of the or per ogether ern gun plus the ed over e inner a little while It slips press- before call- e pro- retain it was ust the inside

shell is obtained as the result of a band of copper, firmly fixed to the shell, being forced into the grooves as soon as the shell starts through the gun. The grooves are spiral cuts in the lining of the gun. In the 14-inch gun the grooves are uniform in twist. They are cut to a depth of about one twentieth of an inch, and are somewhat wider near the muzzle than at the breech. The grooves complete a circle in about twenty-four calibers. In the 14-inch guns this gives the shell one twist in 28 feet. Thus, throughout its trip through the air the shell revolves once in every 28 feet covered. The groove is cut from the muzzle end by a cutting machine similar to a lathe.

The bore is "lapped" with three sets of tools as shown in the accompanying photograph. Emery and oil are used freely. Lapping removes burrs caused by grooving.

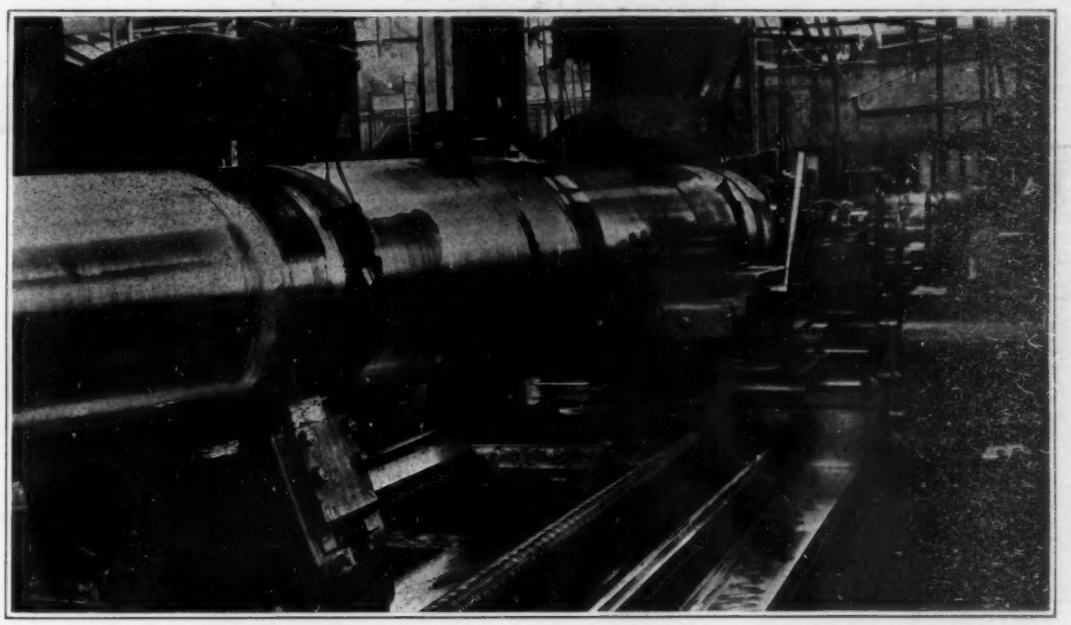
No improvement has been made in the manner of fitting the breech mechanism, which is simply two inches larger throughout than the mechanism used on the 12-inch guns. The yoke in the new 14-inch gun is screwed on and is considered a part of the gun. A shoulder prevents a forward movement of the yoke, and steel rings prevent it from going to the rear.

The gun is then declared to be finished. It is fitted to its trunnions and slide and carefully balanced. The sights are attached to the slide, or carriage. The gun and carriage are then shipped to Indian Head, Md., for a test of five shots with excess charges of powder. It is returned to the gun factory, smoothed over and coated with oil and white lead, and stored for future use.

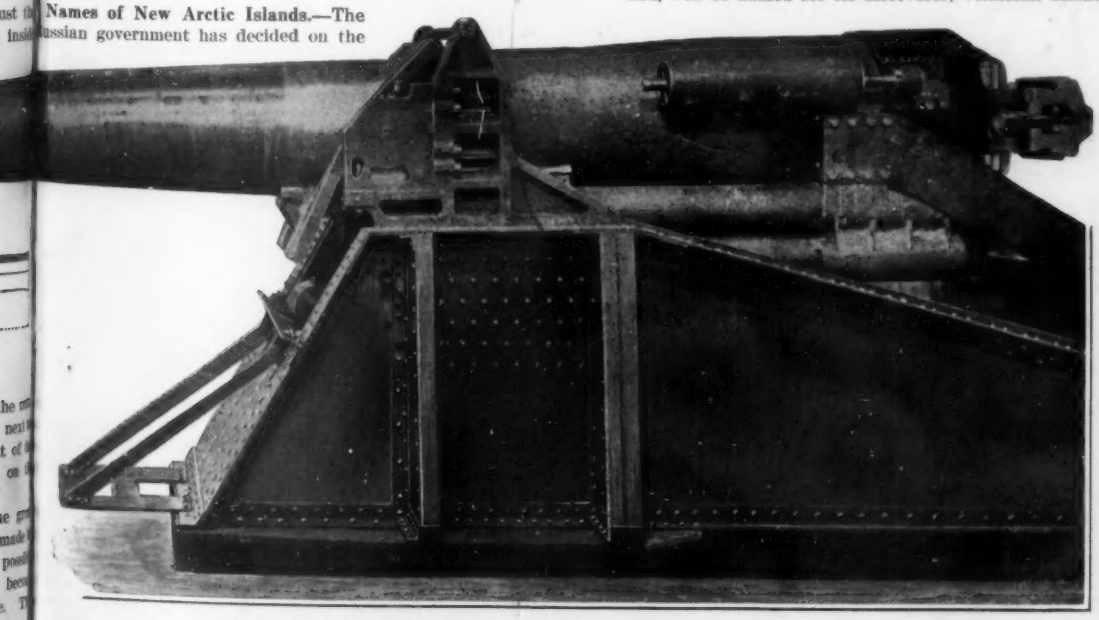
Following the "New York" and "Texas" will come the Nevada" and "Oklahoma." These ships are nearing completion. They will carry ten 14-inch guns in four turrets. The "Pennsylvania," authorized in 1912, and "Battleship 39," recently authorized, will carry twelve 14-inch guns in four turrets. This, of course, means three guns in each turret.

Here are some of the characteristics of the 14-inch gun. It is 45 calibers in length, that is 52 feet 6 inches. It weighs 63.4 tons, has a muzzle velocity of 2,600 feet per second, and fires a shell weighing 1,400 pounds. At a distance of 10,000 yards the shell will penetrate over sixteen inches of the hardest Krupp armor.

Names of New Arctic Islands.—The Russian government has decided on the following names for the three islands north of Siberia discovered by Lieut. Vilkitskii (Wilkitsky) last summer. The large island north of Cape Chelyuskin, the coast of which was followed for a distance of about 200 miles, is to be called Emperor Nicholas Land; the smaller island, lying south of this, Czarevitch Alexis Island; and the small island discovered northeast of the New Siberian Islands and southeast of Bennett Island, will be named for its discoverer, Vilkitskii Island.



The turning and boring of the gun is done in large lathes constructed especially for this work.



The new 14-inch gun which is being mounted on our latest battleships.

This piece is 52 feet 6 inches long; weighs 63.4 tons; fires a 1,400-pound shell with a muzzle velocity of 2,600 feet per second and a muzzle energy of 65,606 foot-tons.

The U. S. Government as a Map Publisher

THE Superintendent of Documents has just published a revised edition of his Price List 53, "Maps Published by the United States Government." The great number and varied character of the maps listed in this pamphlet is the more surprising in view of the fact that it is really far from being a complete list of the maps published by the Government, but merely an enumeration of those offered for sale by the Superintendent of Documents. The four great Government map publishers—the Geological Survey, Coast and Geodetic Survey, Hydrographic Office, and Post Office Department—sell their own maps, and are not represented in this pamphlet, and the same is true of a few other map-publishing offices, such as the Mississippi River Commission. Americans who are fond of patriotic superlatives may rest assured that the United States Government is, collectively, the greatest map-publishing institution in the world. What is much more important, the maps issued by our Government compare favorably in workmanship with the best cartographic productions of foreign countries—a fact that helps to make amends for the disgracefully crude and inaccurate maps contained in most of the American-made atlases offered for sale in our book-shops.

How Long Has an Animal Been Dead?

THE time of an animal's death and thus the age of meat is determined by E. Lenk by a new method, which consists in noticing the variations in weight undergone by placing animals' flesh in water or saline solution, and he thus observes modifications which the microscope or chemical methods fail to reveal. Examining the weight of a piece of fresh muscle, he finds a continuous increase of weight up to 30 hours after the animal's death. After this the muscle loses not only the water it had absorbed, but also a part of its own. The progress of the muscle's swelling is related to the establishment or relaxation of the cadaveric rigidity. When the muscle takes up water, this is due to absorption of water by the biocolloids, caused by production of lactic acid after death. As this lactic acid becomes concentrated in the muscle, the albuminoid substances which become reduced to the state of flakes, become incapable of retaining the water absorbed. The process of unswelling which follows corresponds to the relaxation of cadaveric rigidity. He finds that the nature of the liquid used, and also osmotic pressure, enter in here, and it is known that lactic acid production after death makes a complete change in osmosis. While the osmotic pressure of living muscle corresponds to a 1 per cent common salt solution, it requires a 30 per cent solution to compensate the osmotic pressure of meat of a certain age, such as is found in commerce. Such a method has an interest for food analysis and legal medicine.

Cover Your Bottles With Leather

IN carrying a small bottle, for instance, of medicine on a voyage, it is an excellent plan to make a leather covering for it, and this is easily done. In this way if the bottle breaks there is no danger from wounds caused by the glass, and the cover acts as a good protector. For a square section bottle, trace the profile on a piece of leather four times side by side, and add the small square representing the bottom, to one of the profiles. Cutting out with the scissors, this makes only one seam at the end to be sewed up, also the parts at the neck of the bottle, and the bottom piece.

Where People Live in Hives

IN Mesopotamia the traveler sees a quaint form of dwelling, built of mud bricks in the form of a hive. Villages and whole towns in this peculiar form of architecture are met with. As the country is destitute of trees from which to hew rafters, and also devoid, in parts, of stone, the natives build their habitations of sun-dried mud bricks with high steep domes, similar in shape to a bee-hive. Our illustration depicts one of these bee-hive villages not far from Aleppo, on the route of the famous Bagdad Railway. Each home consists of several of these hives standing near together, and surrounded by a wall of similar material. One or more are used to live in, another for the animals, and still another serves as a granary, and so on, according to the possessions of the proprietor. One dwelling is seen without its outer covering of clay. The smaller conical piles are of dried manure, used for fuel.

Mosolmeieh, a "bee-hive" village, near Aleppo, Syria.

Safety Campaign Car

SENDING a "Safety First" campaign car over its entire lines, and instructing its employees in safeguarding not only their own lives, but the lives of the public as well, is the latest development in the campaign of safety waged by the New York Central Railway. This is the first instance of such an exhibit traveling in a railroad car, and the instruction given through its equipment is doing much to decrease accidents. The car has been in operation but a few months, and already records show that there have been thirty-five fewer employees killed while on duty than for the same period of last year. This, of course, covers the entire system of the road. As an educational feature, the car is especially interesting to the general public as well as to the employees of the railroad. Its lessons are all strongly impressed upon the minds of the onlookers, by a system of "Seeing is believing." Models of all machinery used by the company are shown, together with the right and wrong method of guarding dangerous parts. Photographs on one side of the car picture to the audience unsafe practices of railroad employees. The trespass danger is very forcibly shown by a number of photographs illustrating how persons risk their lives needlessly walking on railroad property. Above these pictures is a statement calling attention to the fact that no less than ten thousand such danger-defying people are killed on the roads of this country each year. One model of especial interest is that of the modern freight car with all its up-to-date mechanism and safety appliances. Attached to the exhibit car is a coach to be used as the lecture room, and this is equipped with a stereopticon by means of which illustrated lectures on safety are given to the men employed by the road.

Railroad car fitted up as a traveling exhibit of safety appliances.

A Giant of the Foundry

THE casting shown in the illustration is the low-pressure cylinder of a Corliss engine having a stroke of 5 feet and bore of 7 feet 2 inches. It is a single piece of iron, weighing 90,000 pounds. Some idea of its size can be obtained from the fact that a man of more than average height standing within the cylinder can just reach the top with the tips of his fingers, while the four shop helpers can easily crawl through the openings for its great valves. Those who are at all familiar with the trials that beset the molder can form some idea of the extreme difficulty in making a casting of such dimensions and weight. The steam ports indicated by the position of the right hand of the man to the extreme left of the illustration, required the most elaborate coring, and this particular piece of work was a most difficult operation.

Low-pressure cylinder of a Corliss engine—a 90,000-pound casting.

The "Marble Light"

IN a recent number of *Umschau*, Dr. Voege comments upon the invention of "marble light," in other words, the utilization of translucent plates of marble in place of opal or ground glass for illuminating bodies. The name "marble light" does not seem to be very happy, for we do not speak of a milk or frosted glass light. However, the name is short and a better designation which is not more complicated can hardly be found.

That marble in thin plates, particularly the colored varieties of marble, render it possible to obtain very beautiful effects has long been known, but the difficulty of producing thin marble sheets at a low price has made it impossible to utilize the discovery in a practical way. Latterly, a Hamburg engineer, W. Engel, has succeeded in making marble plates varying in thickness from 3 to 20 millimeters by means of a special grinding and saturating process. It is said that his marble plates permit a greater amount of light to pass through than ordinary frosted glass plates.

The marble plates are first ground down on both sides, and afterward saturated in oils of various kinds at high pressures and temperatures. Very beautiful effects are produced which it is said can hardly be obtained with colored glass.

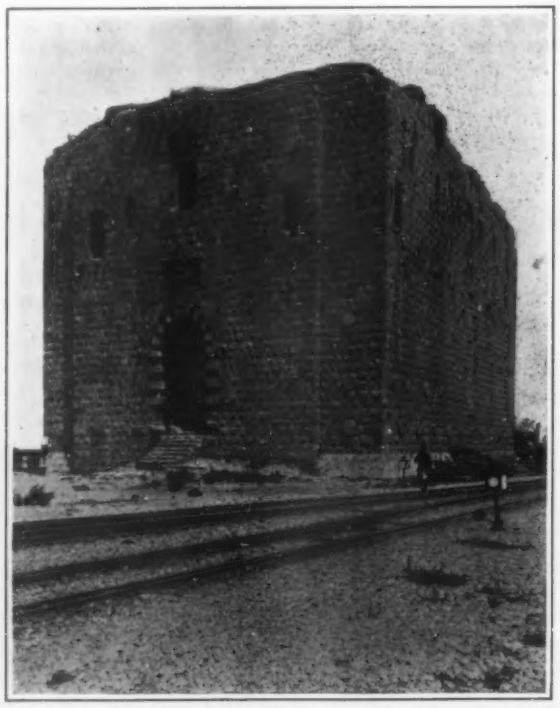
But pure white marble plates are also made, which, it seems likely, will compete successfully with opal glass. Less light is absorbed than with glass, and the color obtained is more agreeable. Most opal glass imparts to the light a greenish hue; the tint of the light which passes through the marble plate is rather a reddish violet, and, therefore, much more agreeable.

Caprifying Smyrna Figs

THE annual report of the Bureau of Plant Industry announces an important discovery in connection with the cultivation of Smyrna figs; viz., that the caprifigs may be carried over winter indoors if packed in boxes alternating with layers of sand. This discovery assures to the fig grower a supply of caprifigs regardless of the severity of the winter.

Old Crusader Tower to Be Demolished

JUST outside the Syrian port of Tripoli, lying alongside the railway track, is a famous old fort, known as the Tower of the Lions, from the tradition that it was built by Richard the Lion-Hearted, of England. As a matter of fact, it is one of six such forts built by the Crusaders to protect the coast, only one other of which exists, and which is in a poor condition. Now the Tower of Lions is to be demolished to make room for the railway, much to the discomfiture of archaeologists who would like to see this old tower preserved as a relic of antiquity.



Castle of the Lions on the Bagdad Railway, soon to be torn down.

Switzerland has four co-operative associations for the growing and marketing of forest products.

New European Designs in Aeroplanes

The Short Folding-Wing Sea-Plane; Three New French Flying Machines

By European Correspondents of the SCIENTIFIC AMERICAN

The Ruby torpedo.

The F. B. A. flying boat.

The new "total vision" Blériot monoplane.

Three New French Aeroplanes

By John Jay Ide (Paris)

The Ruby Torpedo

OVER two years ago there appeared in France a machine which sounded a new note in monoplane design. This aeroplane, the Tatin-Paulhan torpedo, was distinguished by the fact that the screw, at the extreme rear, was driven through a long shaft by a motor placed in the body behind the pilot's seat. From various causes the Tatin-Paulhan, although perhaps the most efficient machine of its day, was not placed on the market. Louis Paulhan soon turned his attention to Curtiss hydro-aeroplanes, which, however, have since been taken out of his hands.

In response to the desire of the French government for armed aeroplanes several manufacturers have reverted to the Tatin design which permits mounting a gun in the bow. The Borel firm exhibited a machine of this type at the last show in Paris. Unfortunately, owing to lack of orders, the Borel factory is at present closed down. Meanwhile a new "torpedo"—the Ruby—has made its appearance. The fuselage of this machine is of the usual box girder type, tapering toward the bow and stern. The wings are of Blériot section. The empennage is "floating," i. e., it carries no load, being perfectly flat above and below. The elevator flaps have their rear edges cut out to allow room for the propeller. Two unbalanced rudders form the terminations of two fins which, like the horizontal tail surfaces, are triangular in shape.

The landing carriage is composed of two pairs of V struts from which the axle is sprung by means of rubber shock absorbers. It will be seen that the lower wing cables are not attached to the chassis, but to a bottom pylon similar to the upper one. This is a very good feature. On too many machines wing cables are still anchored to the chassis. The danger of doing this comes from the fact that the pilot may crack a chassis strut and go up again without having it repaired.

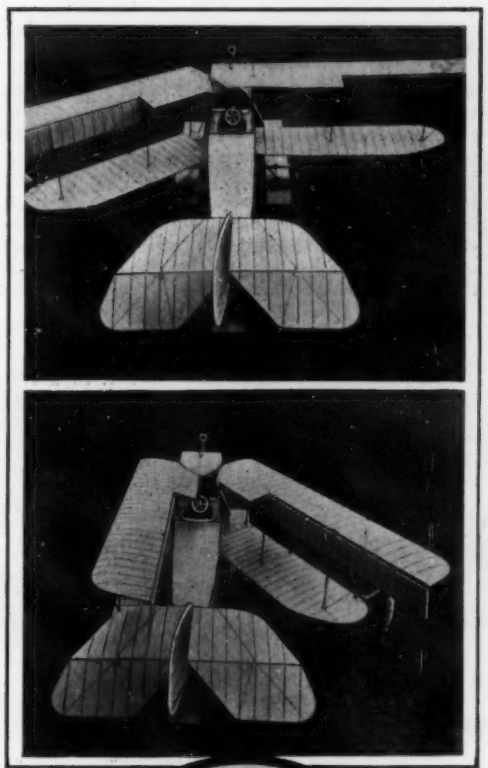
The spectator is at once struck with the great height of the fuselage above the ground. This is needed to give the propeller sufficient clearance. Also in order to bring the machine to a stop within a reasonable distance the axis of the fuselage is inclined so that the nose is considerably higher than the stern. This, however, is not enough to render the braking effect comparable to that of a standard type monoplane. The great height moreover renders landing on rough ground a rather delicate proceeding attended with some risk of overturning. It may be said that the necessary height of the fuselage is the one great inherent defect in the "torpedo" class of monoplane; the only possible remedy would be to replace the propeller by a Coanda turbine propulsor. The cooling of the motor—an 80 horse-power Gnôme—has been found perfectly satisfactory, thanks to the louvers for the admission and exhaustion of air. Small points to be noted are the neat mica wind-shield for the protection of the pilot, and the aluminium cone effecting the final "run off" of the propeller boss. The span of the "Ruby" is 29 feet 6 inches and length 23 feet.

The F. B. A. Flying Boat.

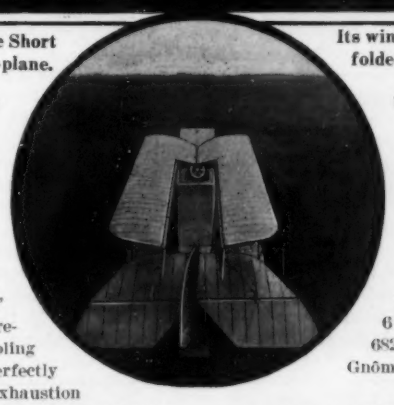
This hydro-aeroplane, produced by the Franco-British Association, is a development of the Donnet-Lévêque, with which André Beaumont did so much flying in 1912. The company, which was formed last year, also manufactures the Curtiss and d'Artois sea-planes. The creation of this company was an eminently sensible way of solving the difficulty presented by the fact that Curtiss held patents covering the "flying boat," a term used to designate a hydro-aeroplane having a central float serving as a fuselage.

Particular care has been taken in designing the shape of the hull in order to reduce skin friction to a minimum. In this respect the new F. B. A. is an improvement even over the machine exhibited at the Paris show last winter. It will be noticed that the deck forward has a slight overhang to prevent water being shipped. The ports for inspecting the compartments in the hull can also be seen. The dimensions are somewhat smaller than those of the Salon machine, which had 39 feet 8 inches span and 25 feet 6 inches length. The 80 horse-power Gnôme motor can be started from the pilot's seat. The controls are standard, i. e., a universally jointed lever works the elevator and ailerons, and a foot bar is used for steering.

The Short sea-plane with folding wings.



The Short sea-plane. Its wings folded.



The Bleriot "Total Vision" Monoplane.

This machine, the latest production of Louis Blériot, and shown at the recent Olympia Show in London, resembles the classic "XI," except that the wings are raised above the fuselage to the level of the pilot's eyes. The pilot can see downward as well as if the plane were above him, and also, by merely turning his eyes upward, can see anything overhead. It would be difficult to overestimate the importance of having a clear field of vision both above and below, which has hitherto been unobtainable on tractor monoplanes.

The credit for this innovation belongs to a French military aviator, Lieut. Gouin. In the machine with which he has been experimenting he has also incorporated a system of air braking, modifying the wing section and rudder for the purpose. The wings present the ordinary Blériot section near the fuselage, but their angle progressively diminishes toward the extremities, where it becomes zero. The axis of rotation of the rudder forms the summit of a dihedral angle, which in normal flight is closed. When a braking effect is desired the rudder is opened out by a foot-operated control. The braking effect is, of course, proportioned to the opening of the dihedral angle. This feature is especially useful at the moment of landing, as it causes the machine to quickly come to a stop. A Blériot type Gouin has been entered in the Concours pour la Securité en Aeroplane. In the Blériot license Gouin, as the ordinary total vision type is called, the air braking feature is not incorporated.

Owing to the raised position of the wings the lower wing cables work at a more favorable angle than before. The pylon is of the standard "XI" type, but raised on four struts. A two-seater tandem "XI" bis with the total vision feature is now being completed by the Blériot firm.

It will be noticed that Blériot has thought fit to preserve the landing carriage in its original form. This member of the new monocoque is considerably smaller and has, therefore, much less wind resistance. While retaining his original chassis Blériot has at last given up the well-known "cloche" control. The wing warping and elevator are now controlled through a vertical lever mounted on a longitudinal rocking shaft. This shaft carries at its rear end a sprocket connected by chain to another sprocket on the lower end of the bottom pylon. On the same shaft as the pylon sprocket there is a pulley around which pass the warping wires. The elevator control wires are fastened directly to the vertical lever. The rudder is operated as before by a foot bar. Following are particulars of the Blériot total vision machine: Span, 30 feet 2 inches; length, 25 feet 6 inches; area of main plane, 194 square feet; weight (empty), 682 pounds; useful load, 309 pounds; motor, 80 horse-power Gnôme; tractor, Chauvière; speed, 68.2 miles per hour.

The Short Folding-Wing Sea-Plane of the British Navy

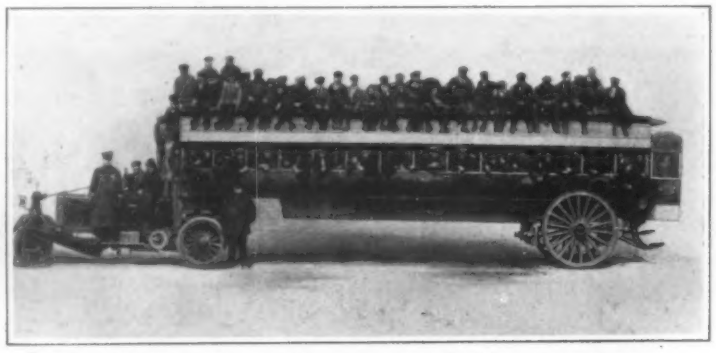
By Major H. Bannerman-Phillips (London)

WHILE Great Britain has marked time too long since the disaster which befell her first large rigid naval airship at Barrow in 1911, and is only now beginning to make some headway with lighter-than-air vessels for oversea work, she has by close attention to detail on the part of constructors and devotion to duty on that of the naval personnel of all ranks concerned with flying, taken the lead in sea-flying, and the latest development of the Short sea-plane marks a long step forward in the matter of equipment for naval aviation. The radius of action of the sea-plane is at present limited, whereas that of the large rigid airship of the Zeppelin type may be put at 750 miles, and communication by wireless over 300 miles has been accomplished; but if the plan be adopted for working the sea-plane from a ship, the actual radius is not so important as it would be otherwise. There are, of course, three main difficulties to overcome in the care of sea-planes using the vessel of war to which they are attached as their base. The first is the question of stowage on board ship; the second, that of starting; and the third, that of alighting or being hoisted on board. It has been suggested as an alternative to this that a sea-plane accompanying a fleet should be fully sea-worthy and capable of riding out bad weather if it should be unable to reach land by its own power. Apart

(Continued on page 405.)

Historic Omnibus "Motorized"

THE accompanying photograph shows an old omnibus which plied between the Centennial Exposition and the City Hall, Philadelphia, Pa., in '76, being drawn by ten horses and carrying loads of from sixty to one hundred passengers. The old 'bus has been doing service in Brooklyn for the past thirty-five years with picnic parties and holiday excursionists. It has just been "motorized" with a tractor. In spite of its great age this old vehicle has been well kept, and is in a remarkably well preserved condition; in fact, it is still so serviceable that its owner proposes sending it overland along the Lincoln Highway route to the Pacific Coast to run between the heart of San Francisco and the Panama Exposition.



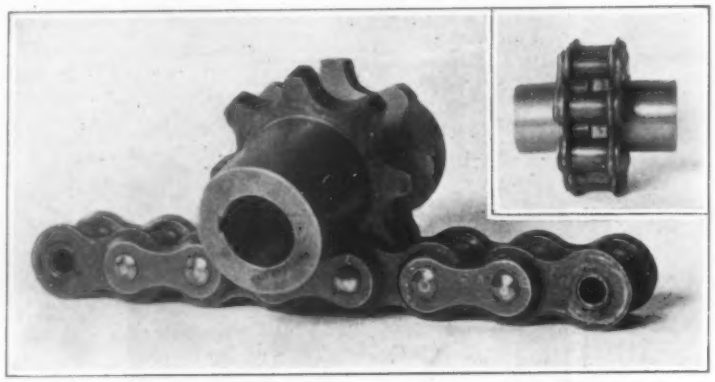
Centennial Exposition omnibus now equipped with a motor tractor.

Indian School of Tropical Medicine

THE American consul at Calcutta reports that the corner-stone of the new School of Tropical Medicine at that place was laid on February 24th by the Lieutenant Governor of Bengal, and the institution is likely to be ready to begin work in a year's time. This school will have unique advantages for carrying on its special line of work; viz., the study of tropical diseases, with a view to finding more accurate methods of diagnosis and treatment. Such diseases are responsible for more than one third the mortality in the city of Calcutta. From the consul's report it appears that the new institution aims to become an international center in its particular field, students will be welcomed from all parts of the world, and medical research institutions in other countries are urged to establish scholarships at the Calcutta school, or to provide otherwise for sending research students to enjoy the advantages it offers. Inquiries should be addressed to Lieutenant Colonel Leonard Rogers, I. M. S., Medical College, Calcutta.

Simple Flexible Coupling

A VERY simple flexible coupling has recently been invented which consists merely of two sprocket wheels held together by a roller chain. The sprocket wheels are keyed to the shafts that are to be connected, and then the coupling is readily effected by wrapping the roller chain about the two sprockets and clasping the chain with a master link. The shafts may as readily be disconnected. The coupling has great strength because all the teeth are in contact with the chain rollers at one time. A roller bearing, instead of sliding contact is thus provided. The chain adjusts itself automatically to all variations of alinement within wide limitations. The coupling has no projecting parts, and hence it meets with all legal requirements for safety.



Flexible coupling consisting of two sprockets and a roller chain.

The New First Assistant Patent Commissioner

THE vacancy caused by the death of Mr. Robert T. Frazier will be filled by James T. Newton, at present Assistant Commissioner in the Patent Office. On April 24th President Wilson confirmed Mr. Newton's appointment as First Assistant Commissioner of Patents. Mr. Newton was appointed to the Patent Office March 25th, 1901, as an assistant examiner. Later he became examiner, and on November 14th last was promoted to the position of Assistant Commissioner.

Mr. Robert T. Whitehead of Virginia has been appointed Assistant Commissioner of Patents by the President. Mr. Whitehead entered the Patent Office as an assistant examiner on February 1st, 1902, and was made a law examiner July 1st, 1909.

Motor Car Converted Into Railroad Tractor

MULES proved unsatisfactory in hauling materials about the site for the Marconi wireless telegraph station at Kahuku, near Honolulu, Hawaii, and an old automobile in which the engine was quite sound was resurrected from a life of uselessness and remodeled as shown in the accompanying illustration for use as a narrow-gage railroad tractor. It can readily haul a number of cars. Prompt response with its three speeds forward and reverse has gained this tractor the favor of the workmen, to whom mule power proved as much of a hindrance as a help.

Motor car tractor in Hawaii.

Cottonseed Flour as a Possible Food for Man

By C. A. Wells

ONE of the earliest reported cases of the use of cottonseed flour as a food for man was that in which bread and other articles of food prepared from cottonseed meal were served certain members of the Farmers' Congress held at College Station, Texas, about fifteen years ago. Since that time a number of reports have been made of the use of the meal in human diets.

Allison states that many of the smaller cottonseed oil mills of the country are manufacturing so-called "cottonseed flour" and that some of the large mills are producing and disposing of it with profit. It is not manufactured by any secret process, but is simply cottonseed meal of choice color, taste and odor which has been finely ground and thoroughly bolted. As might be expected, therefore, it contains more protein and less crude fiber than cottonseed meal of similar grade and origin. In other respects the chemical composition of the two is essentially the same. The terms "cottonseed flour" and "cottonseed meal" are used synonymously throughout this paper.

Cottonseed flour contains little kneading principle and more than twice as much protein as meat. In order, therefore, to facilitate the making of bread and at the same time reduce the protein content of the latter, the flour is usually mixed with some other substance such as wheat flour. Most of the cottonseed flour bakery products found on the market are prepared in this way.

In 1912 there were crushed in the United States 4,921,073 tons of cottonseed equivalent to about 2,160,000 tons of meal. If we make the reasonable assumption that cottonseed meal has a digestibility of 70, then on the basis of the food values one ton of meal has a protein calorific food value of $495.60, or a total calorific food value of $555.37. Until 1898 nearly one half of the annual production was exported, the remaining half was fed to stock or used in making fertilizers. The Interstate Cottonseed Crushers' Association arbitrarily classifies cottonseed meal into three grades: choice, prime and off grades. Choice meal is from choice cottonseed finely ground. It must be perfectly sound, sweet, and of a light yellow color, free from excess of lint and hulls. It might be inferred that meal of this grade would be suitable for human consumption. Unfortunately, however, we have no record of the quantity of each grade of meal manufactured, so that one has no accurate data upon which to base a calculation of the amount of meal even presumably of a grade fit for man's use as a food. On the percentage basis, however, if cottonseed meal can be used as a food for man, and if it has a digestibility coefficient of 70 or greater, then 10 per cent of the meal produced annually in the United States (10 per cent of 2,160,000) would have a total calorific food value of $119,959,920 and a protein value of $106,920,000 (216,000 multiplied by $555.37 and $495.60, respectively). The same meal when fed to stock or used as a fertilizer would have a value not exceeding $6,480,000 (216,000 × $30.00, a liberal commercial value of one ton of meal).

Allison, Thompson, and others state that it is a suitable food stuff for man and that in many cases its continued use has proven highly beneficial. According to Fraps, "we have no reason to believe that cottonseed flour will not be a wholesome food, when used in small amounts to replace meats, or to reinforce a diet poor in flesh food," yet he says further, "we are inclined to believe that the maximum amount of cottonseed meal which should enter into the diet is two to three ounces per day; that the conditions under which such a diet may prove injurious must be established; . . . and that only experience and experiments can tell us the part which cottonseed flour should play in nutrition and under what conditions it may prove unwholesome." The writer has eaten for some time in his own home cakes and bread of various kinds containing a portion of cottonseed flour without experiencing any ill effects from its use.

It should be said, however, that while there are no reported cases of injury from the use of the meal as a food for man, it is possible and indeed quite probable that this is due to its so far limited use for this purpose. The assumption of its unwholesomeness for man naturally grows out of the well known injurious effects which it produces when fed to stock. Investigations are now under way to ascertain the true nature of cottonseed meal toxicity. If this can be done, cottonseed meal or flour may be given to the world as a new and exceedingly inexpensive food with an almost unlimited source.

"Snow Mushrooms"

THIS name is applied by Dr. Vaughan Cornish, in his recent book on "Waves of Sand and Snow," to some remarkable snow formations observed by him in traveling through the Selkirk Mountains, in western Canada. The railway passes through a pine forest, in which many trees have been cut at a height of about 6 feet from the ground. On the tops of the stumps, which are about 2 feet in diameter, snow collects in an overhanging cap like that of a mushroom. These caps, which sag at the border, and rise in a dome in the middle, are generally about 9 feet in diameter; i. e., they project 3½ feet beyond the stumps all around. Of hundreds observed by Dr. Cornish, all were perfect, none having broken with their own weight. Some of them must weigh more than a ton. Several photographs of these curious mushroom-like formations are shown. The whole phenomenon calls for exceptional meteorological conditions, and in this respect is analogous to the "snow garlands" described and illustrated in the SCIENTIFIC AMERICAN of January 27th, 1912.

The Forests of Norway are mostly in private or municipal ownership, the nation owning 28.5 per cent of the total forest area. The national forests of the United States occupy only about twenty per cent of the total forest area of the country.

LEGAL NOTICES

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Inquiry No. 9357. Wanted the name and address of a manufacturer of a machine for scalloped paper favors and cups.

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Inquiry No. 9359. Wanted the name and address of a firm that makes razor blades for all makes of safety razors.

Inquiry No. 9360. Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

Inquiry No. 9361. Wanted to buy a Nut Cracking Machine, especially good for Pecans.

Inquiry No. 9362. Wanted the name and address of the makers of a machine for splicing ties.

Inquiry No. 9363. Wanted the names and addresses of manufacturers of machinery for printing on intaglio copper plates.

Inquiry No. 9364. Wanted the name and address of buyer of mica in a crude state.

Inquiry No. 9365. Wanted the name and address of a manufacturer of machinery for embossing tin foil as is used in packing cigarettes.

Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks, pressed steel frames, mufflers, motors of the two-cylinder opposed type, cushions and many smaller parts for cycle cars.

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automatic centering machine.

Inquiry No. 9368. Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 9370. Wanted the names and addressess of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of manufacturers of a collapsible box about 12 inches square. It must be strongly made to withstand rough usage in transit.

NEW BOOKS, ETC.

NAVAL WARFARE. By James R. Thursfield, M.A. With an Introduction by Rear-Admiral Sir Charles L. Ottley, K.C.M.G., C.B., M.V.O. New York: G. P. Putnam's Sons, 1913. 16mo.; 151 pp. Price, 40 cents net.

"Naval Warfare" is sufficiently technical without being tedious. Very few men, even among the well informed, know anything of even the broadest principles of the conduct of sea fighting, although these principles are, as Sir Charles Ottley says, precisely the same to-day as they were at Salamis and Lepanto. The little work briefly but very readably discusses the command of the sea, disputed command, invasion, commerce in war, and the differentiation, distribution and supply of naval force. It is the vote of the civilian that provides or withholds ships and munitions of war, and it is the duty of every civilian so to familiarize himself with the basic conditions of success in warfare that his influence may be exerted intelligently. Prof. Thursfield's manual, if universally read, would greatly forward this happy consummation.

COAL TAR DISTILLATION. And Working Up of Tar Products. By Arthur R. Warnes. New York: D. Van Nostrand Company, 1914. 8vo.; 185 pp.; illustrated. Price, $2.50 net.

The complex mixture known as coal tar is the basis of a very considerable industry, and a compact, up-to-date work dealing with the industry in its many phases will be appreciated by students, managers of plants and technologists. In brief but informative chapters, the author discusses the various processes used in distillation, in the recovery of acids, benzols and pyridine acids, and in the manufacture of such products as crude naphthalene and anthracene. Tar works' tests are given in the final chapter. Throughout the text figures are tabled for change-over points, temperatures and results. These are taken from actual practice, and will be helpful in a large degree, though the author warns the student that coal tar and its distillates are variable mediums, and processes that have succeeded in some instances might have to be modified in others.

INCANDESCENT ELECTRIC LAMPS. And Their Application. By Daniel H. Ogley. New York: Longmans, Green & Co., 1914. 12mo.; 107 pp.; illustrated. Price, 80 cents net.

Recent improvements in electrical lighting mean chiefly improvements in the filament. The semi-popular handbook offered in "Incandescent Electric Lamps" eliminates much phraseology that has been unintelligible to the layman, and aims at filling "the obvious gap." Illumination and its measurement, standard light sources, light distribution, the eye and the principles of vision—these captions give some idea of the discussions involved. Direct and indirect lighting systems are explained and contrasted, and it is hoped that the general reader may profit to the extent of acquiring such information as may enable him to select the best instalment for his own particular needs.

THE SHIPPING WORLD YEAR BOOK. 1914. Edited by Major Jones. London: The "Shipping World" Offices. 8vo.; 1912 pp. Price, $4.

The "Year Book" is issued as a desk manual in trade, commerce and navigation, and is too well known to require a lengthy description. It is packed from cover to cover with thousands of facts having a direct bearing on the shipping business. Prominent among its offerings are the tariffs of all nations, a complete port and harbor directory of the British Isles and a directory of all the commercial ports of the world, with particulars as to accommodation, charges, tides, trades, pilotage and towage. Bartholomew's latest map of the world is, as usual, a feature of the new edition, and shows in distinguishing colors steamship and railway routes the world over.

THE FERTILITY OF THE SOIL. By Edward J. Russell, D.Sc. (Lond.) Director of the Rothamsted Experiment Station. New York: G. P. Putnam's Sons, 1913. 16mo.; 128 pp.; illustrated. Price, 40 cents net.

No grower can afford to ignore the basic processes of plant growth and the attainment of maximum fertility for his ground. In this little volume close attention is given to means for raising the fertility limit, and the illustrations show striking results. Partial sterilization, by toluol or by heat, effects a marvelous increase in crop. The six vital requirements—moisture, air, heat, nourishment, root room and freedom from harmful factors—are intelligently discussed. Phosphates are, of course, given the attention they deserve.

MOUNTAINS. Their Origin, Growth and Decay. By James Geikie, LL.D., D.C.L., F.R.S. New York: D. Van Nostrand Company, 1914. 8vo.; 311 pp.; illustrated. Price, $4 net.

The author is peculiarly successful in conveying hard facts in a pleasurable manner without catering to sensationalism on the one hand or losing the average reader by technical intricacy on the other. His discourse classifies mountains as original or tectonic—including the volcanic and epigene types of accumulation mountains—and subsequent or relict mountains. It is the borderland of geology and geography through which we are guided so masterfully in this fascinating journey of exploration. We investigate old Scottish volcanoes and glacial and aeolian hills; we study the architecture of the Alps; we plumb the submarine ranges of the Pacific. The many plates accompanying the work are of a high order of merit, admirably illustrative of the features

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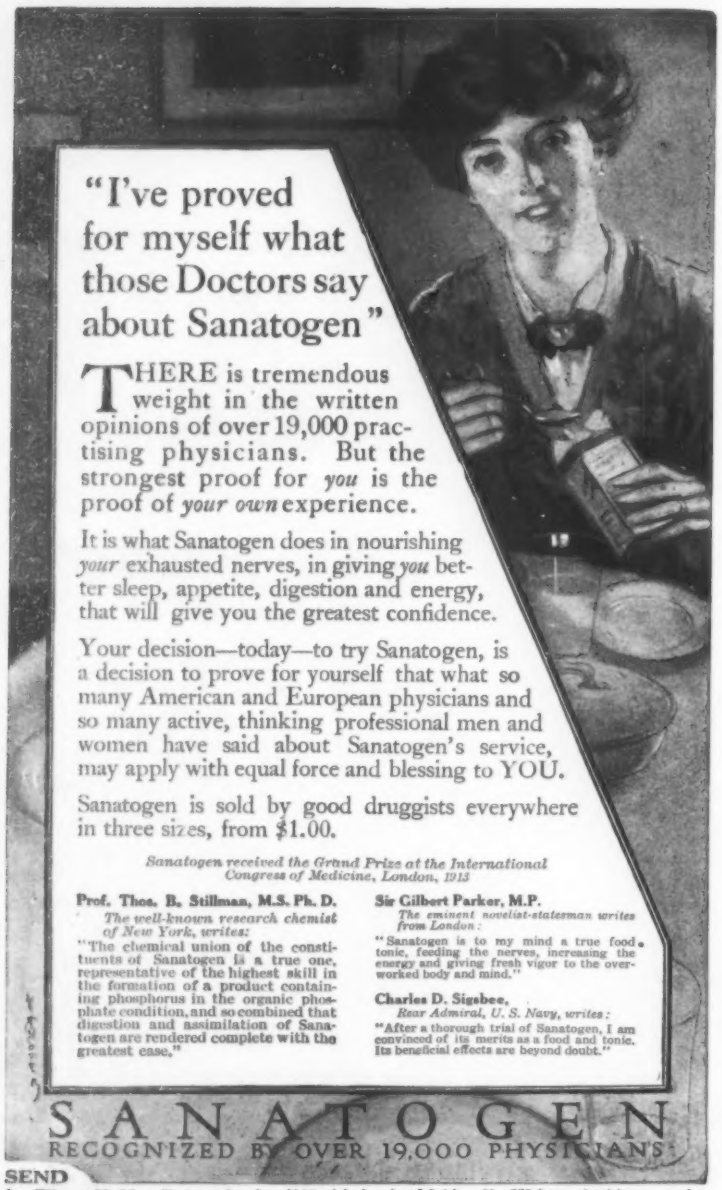
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to which our attention is called. The numerous diagrams are carefully drawn, and such folding inserts as the bathyorographical map of the Pacific Ocean and the cross-sectional layouts of the southern uplands of Scotland are vastly instructive. Prof. Geikie is an adept at turning for us the captivating pages of the past and in giving us new eyes with which to view the present.

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(12989) G. H. asks: 1. How much will a cubic foot of air weigh when compressed to 6,000 pounds on the square inch? A. It will require four hundred atmospheres to produce a pressure of 6,000 pounds per square inch, and this will compress the air about four hundred times. We say about, since Boyle's law is only approximately correct at high pressures. Air at normal pressure and the freezing point weighs 0.08071 pound per cubic foot. At four hundred atmospheres a cubic foot will weigh four hundred times as much, or about 32.284 pounds. 2. How many parts of air will one part of liquid air make when evaporated? The idea being that it would be better to use liquid air than compressed air for certain purposes when desired to use such away from the compression plant. A. It requires about 800 cubic feet of ordinary air to make 1 cubic foot of liquid air. This when evaporated will yield 800 cubic feet of air again. If liquid air were retained in a closed vessel, the ultimate pressure would be about 12,000 pounds per square inch. We should prefer to be elsewhere when this happened. Liquid air is never kept in a closed vessel. No railroad would receive it for transportation except in open vessels, so that evaporation can go on freely.

(12990) W. N. G. asks: Would it be too much to ask of you to explain the cause of well-defined pictures of various objects such as ships, wrecks, fine buildings, well-known landscapes and various other familiar things, which may be very long distances away, appearing in the frost on windows on very cold days? A scientific explanation of this very strange freak of nature would very much interest me, and probably all of your readers and subscribers. A. When we were children living in a region much colder than New York, we often saw shapes formed by the frost on the window pane, such as those you mention, but we never thought them real copies of objects beyond our horizon. We thought them fancies of our imagination. We do not now know any reason why they should be other than resemblances in the delicate tracery of the frost. We have no scientific explanation for their being any more. There is no possible way in which a ship could produce a picture of itself beyond its horizon.

(12991) F. C. S. asks: Will you kindly inform me upon the following to the best of your ability? On my auto I have four new wheel caps that hold the wheels on the axles. These caps are made of hardened steel, the outside of which is nickel plated. What is the reason, when these caps get wet and stand for a day, the nickel plate blisters and flakes off? These caps are new. Is there anything I can do to the caps to prevent this action on the nickel, and why does the nickel plate blister and flake off hardened steel when it does not do so on other metals that are plated in the same solution? A. The coating of nickel on the pieces of hardened steel does not have as good contact as it would upon soft steel or iron, nor is the nickel continuous. It has pores in it, through which the moisture comes into contact with the steel, and steel rusts much quicker than iron. The great increase in the use of steel is not without its drawbacks. Our galvanized iron and tin plates are no longer made of iron, but of steel, and they are by no means as durable, nor does the coating of zinc or tin adhere so strongly as it did upon the softer and more porous iron plates which were used before the steel processes were developed.

(12992) G. M. asks: Is it possible to construct two vertical lines parallel to each other by means of a freely suspended plumb bob? A. It is not possible to construct two vertical lines by means of plumb lines near each other. Neither can vertical lines be strictly parallel to each other. Vertical lines converge and meet at the center of the earth. If two plumb bobs are hung near each other, neither will hang perfectly vertical. They will draw each other slightly from the vertical by their gravitational attraction for each other. It was by an experiment of this sort that the earth was weighed. For this, see Young's "General Astronomy," page 110. We send the book for $3.05 postpaid.

(12993) P. P. C. asks: Will you kindly give me the proper explanation as to why, in moving pictures, the wheels of vehicles seem to revolve backward? A. If the spokes of a wheel in a moving picture keep time with the exposures, so that the spokes are in the same position in all the pictures, the wheels will be seen to stand still on the screen. If the spokes succeed each other either faster or slower than the exposures of the film, the wheels will be seen to be turning forward or backward, as the case may be. We have observed all three phenomena. They do not always seem to revolve backward.

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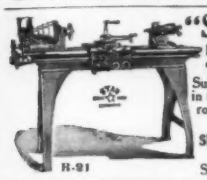

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A Rare Opportunity for a Capable Inventor

By E. W. McCormack

THERE is at the present time an unusual opportunity for an inventor and a manufacturer, to place upon the market a device for which there exists a large demand. The device for which hundreds of firms are seeking, is one that will assist them in putting up their pay-rolls.

Everyone conversant with the subject realizes that the present method of analyzing the denominations of currency needed by cashiers and paymasters, is one of the most troublesome, inefficient and wasteful operations in connection with the weekly or semi-weekly pay-roll. What is needed is a device which will operate upon the principle of an adding machine, but instead of accumulating totals the device should be designed to segregate the amounts into the required denominations.

For illustration, if the first item on the pay-roll is $15.78, it requires a mental operation for the cashier to segregate, upon a separate list, the items which go to make up the amount, i. e., one $10 bill, one $5 bill, one 50-cent piece, one 25-cent piece, and three 1-cent pieces. The entire pay-roll is analyzed in this manner, so that when the pay-roll check is presented at the bank a memorandum accompanies it, calling for bills and coin in the following amounts:

106	$10.00 bills
71	5.00 bills
97	2.00 bills
313	1.00 bills
118	0.50 coins
63	0.25 coins
1,149	0.10 coins
211	0.05 coins
953	0.01 coins

Thousands of firms realize that they are wasting valuable hours, which yearly cost them hundreds of dollars, according to the size of their pay-roll, because there is no simple, efficient, labor-saving device which will enable them to add up the total of their pay-roll and segregate the items into the proper units. Many concerns have their cashiers guess at the amounts, and often their guesses are not good, but, however good the guesses, it simply means that the larger the pay-roll, the more pieces of money it is necessary to handle, because if guesses are made, more bills of smaller denominations must be specified than needed, consequently when two thirds through the pay-roll, it becomes necessary to pick up and count five one-dollar bills instead of having one five-dollar bill.

It should not be any great mechanical problem for an inventor to produce a combination adding machine and pay-roll device, so that the cashier could strike keys 15.78 and have the machine print a line similar to the following illustration:

Amount	$10.00	$5.00	$2.00	$1.00	50c.	25c.	10c.	5c.	1c.
15.78	1	1	...	...	1	1	...	...	3
20.15	2	...	...	...	...	...	1	1	...
18.86	1	1	1	1	1	1	1	...	1
12.11	1	...	1	...	...	...	1	...	1
14.51	1	...	2	...	1	...	...	...	1
etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.	etc.
2131.73	106	71	97	313	118	63	1149	211	953

Such a device as this could be sold for $100 or $200, and the time saved would pay for the machine several times over in the course of a year, as the present method is slow and inaccurate, and, as before stated, one of the most troublesome problems in connection with the handling of pay-rolls.

This opportunity for an inventor is unusual because invariably the majority of inventions of an entirely new idea are ahead of the times, or in advance of actual demand for the device. Regardless of the merits of the invention, if there is no demand, it means that a great amount of educational work must be done before a market can be created. The cost of an efficient sales campaign, along educational lines, coming as it does directly after the experimental and manufacturing expense, is responsible for many disappointments and failures. In many cases it is the man who takes hold of the proposition after the ice has been broken who reaps the greatest financial reward; but, in this particular case, there is a demand already created, as firms are asking for, and willing to buy, such a device, and there is at present nothing to be obtained which will do the work.

New European Designs in Aeroplanes

(Concluded from page 401.)

from the difficulty of finding a suitable engine for such a machine, this would place serious limits to its action, and it might be on land and in its hangar just when most wanted by the vessels at sea; and as to riding out a storm, say under the lee of one of the warships, in the first place, even a boat-shaped hull of the size of a sea-plane, although without the top-hamper of wings, etc., could not be expected to stand all weathers, whereas the planes would offer such a surface to a storm as to make destruction certain. In the second place, the warship under whose lee it would take shelter would be seriously hampered by having to remain in position, since it might have to proceed elsewhere at speed.

It is obvious, therefore, that a sea-plane intended for use with a fleet must be "mothered" by a large vessel and able to not only start its reconnaissance flights from the ship as a base, but send back information while away, and at any time return to it for protection in case of bad weather and get taken on board.

The Short folding-wing sea-plane goes far toward solving the problem of providing a machine which can fulfill these conditions. It is a tractor biplane and has a very wide and relatively shallow fuselage, rectangular in section, with ash longerons and spruce struts. The engine is a 100 horse-power 14-cylinder Gnôme, mounted in steel housings within the fuselage members, and surrounded by a sheet metal cowl with air-holes in the top front for cooling purposes, and on the top there is a chimney to carry away both the air and the exhaust gases. The rounded engine-cowl is carried back and tapered off into the fuselage proper behind the pilot's seat, being cut out and shaped to form a wind-screen for both pilot and passenger. At the rear of the fuselage is the empennage, consisting of a cambered fixed tail-plane, followed by divided elevator flaps, a fixed vertical fin and a balanced rudder.

It will be some time before sufficient experience will have been gained in handling this type of machine on board a warship to say how far the arrangement for folding the wings is of advantage in lowering on the water surface and hoisting inboard, but it has the merit of simplicity, and there can be no doubt of the value of a system which permits of reducing a span of 60 feet to a width of 9 feet when stored in a hangar, a process which only takes a few minutes in this case.

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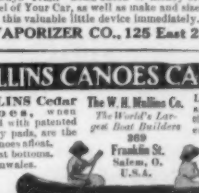

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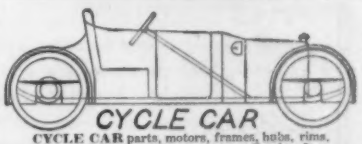

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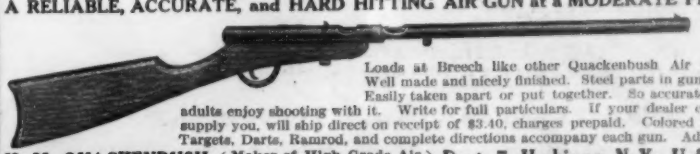

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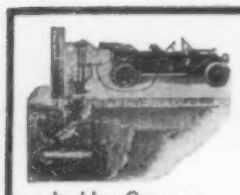
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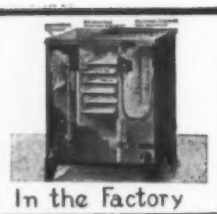
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machines the requisite shed accommodation for an aeroplane base is reduced to one fifth or one seventh, and that this great saving in the cost of sheds will have the result of increasing the amount of money available for the purchase of machines. They also maintain that the value of the folding sea-plane was proved conclusively in the last British naval maneuvers in 1913, when a 160 horse-power Short folder sea-plane was carried on an ordinary warship without the slightest inconvenience (owing to its compactness) and was launched and reshipped many times without the slightest hitch, performing evolutions in rough weather in the North Sea, and that their invention has made possible the project of having an "aeroplane ship" or mother vessel to carry twenty to thirty machines, for which plans are already out.

A noticeable feature of the Short folder sea-plane is that the wings can be folded or spread out at will by the occupants of the machine, while it is floating on the water, a small winch being provided in the machine for this purpose, the whole operation being completed in two minutes. The same operation has been completed in the same time on land at the end of a 7-mile journey, during which the machine was "towed" by road with folded wings, but fully equipped and ready for flight so soon as the wings were spread. In the same way it is possible to carry the machine on board ship, hung in davits, fully equipped and ready to be launched at a moment's notice. Very special care has been taken in the design of the hinges and fastenings for the folder sea-planes and the seven tests to which the "short" machines have been put by the British Admiralty are understood to prove that the strength of the whole structure has been increased by the adoption of the folding-wing fittings.

Aeroplanes have, of course, been launched from special platforms on warships before now and alighted on them in similar fashion, but the carriage on deck of a machine of the ordinary type is obviously out of the question, and the taking down and putting together again for each flight would consume much valuable time; moreover, it would increase the wear and tear of the parts very considerably.

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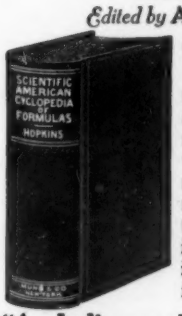

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